THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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THE EVOLUTION OF THE ENGINEERING APPRENTICE.

IN the old days of the Guild companies, an apprentice to any trade was carefully taught his handicraft by his master. Often he lodged with him, and was treated as one of the family, the evenings, after manual work was finished for the day, being devoted to the study of such crude theory as was then known, the master assuming the functions of teacher.

The growth of manufacturing industries exercised a marked effect on the conditions of life, leading to the gradual concentration of the people into groups from which our towns have grown. The steady increase in the size of workshops, and the increased numbers of workers serving an employer of labour, had their effect on the conditions of the apprentice. An employer was no longer able to devote individual attention to his apprentices, who had now to rely for any learning upon the craftsmen with whom they worked. In the early days of engineering workshops, the seven years bound apprenticeship was the regular order of the day, and the youth who had passed through this could turn his hand to almost anything involving the skilful use of tools. But all this has passed away, the old order has changed. The old men, now rare, who call themselves millwrights, who can handle a file or a chisel skilfully, serve only to remind us of the changes that time has wrought during the last 50 years or so.

Specialisation and modern machine tools have entirely changed the conditions of skilled labour, and a lad now enters a works with no indentures of apprenticeship, depending on his wits or his "cheek" for any information he can pick up, and in the end, what is he? A turner, a fitter, a machineman, a driller, &c., or if he is very fortunate he emerges as a tool-maker, now the highest rung of the engineer-workman's ladder.

But modern engineering, which, of course, embraces electrical engineering, has called forth a new industrial unit, in the man who not only can use his hands, when occasion arises, but can also design, plan, organise and carry out schemes of any magnitude. Such a man needs a thorough scientific training, and a knowledge of not only how to use a tool, but of the physical properties of the metals or materials he works with.

Such a man, during his workshop days, must not be confined to the working of a lathe, or machine, but must go through and get a thorough knowledge of the work in every department, including the drawing office. In the early days of electrical engineering, any man who had made an electric bell, or a frictional machine, or who had an influential relative, was dropped upon, or was "pitchforked" into a responsible position. Then came the pupilage system. Manufacturers found that they could get well-to-do men to pay sums of from £300 to £700 for their sons to learn the business, and in some works there were more of these young

gentlemen, or pupils, than workmen. Such pupils came when they liked, and did what they liked, which, generally, was not much. Then the Technical Colleges sprang up, and now the whole country is literally covered with them, pouring out annually thousands of partly trained engineers, many of whom, owing to the glut on the market, are, temporarily, at any rate, forced to take positions in which considerable technical ability is needed, at salaries ranging from 10s. to 30s. a week, or less than the wages of the workmen under them.

The technical college does not, and cannot, teach a man what he learns in a works. The use of tools he may learn, but the knowledge of men, the building of machinery, and the carrying out of contracts on a commercial basis he does not learn. To do this, he must serve some kind of apprenticeship, and hitherto no distinction has been made by employers, so far as the payment of a premium is concerned, between the man who has received a technical college training and one who has not.

But the times are changing. It is becoming recognised that a technically trained man is, or ought to be, a better and more valuable employé than one who has no such training. Thus the Westinghouse Co., in America, now differentiates between the man who wishes to learn a trade, and comes with no technical knowledge, and one who having graduated at some technical college desires to become an electrical engineer. The "ordinary apprenticeship" is for the first-named class, and the minimum age of entering is 17 years. The pay is 5 cents an hour to begin with, rising to 15 cents an hour in the fourth year.

The "engineering apprenticeship" provides for young men who are graduates of technical schools and universities. Such men receive higher wages than those in the first class, and this is the important point. The term of service is two years, and the pay is 16 cents an hour for the first year and 18 cents for the remainder. It is important to note that the men in this class start at higher wages than the others leave off at. They are taken not only through the shops, but also through the engineering, construction, testing and correspondence departments. The latter is a department through which an English apprentice never passes.

It is very satisfactory to note that some English firms, such as Messrs. Wigham, Richardson & Co., the North-Eastern Marine Engineering Co., and other Tyneside companies, have decided to adopt a somewhat similar system. Lack of space prevents our referring now at greater length to this, but we hope to give further details of this welcome proposal in a subsequent issue.

Electricity in Mines.

In another column we give a critical digest of the report of a Committee appointed by the Home Office on the use of electricity in mines. As is there remarked, the report, with the addendum of rules which the Committee consider should govern electrical installations in mines and those in charge, is a praiseworthy precautionary measure. There is no doubt that every safeguard against mishaps, which are too often attended with fatal consequences, should be insisted upon. The chief objection to the report is the absence of even an opinion as to the best type of machinery and apparatus for mining purposes. It is all very well to insist upon precautions being taken with machinery which is inherently bad for use in fiery mines, but it would be far better to direct the attention of mine-owners and engineers to the apparatus which would most nearly meet the approval of inspectors appointed to see that the rules are carried out. A certain amount of latitude should be, and is, allowed, but when sparkless machinery is available, why not, at any rate, advocate its universal adoption?

The Fees of an Arbitrator.

Electrical and other engineers are frequently called upon to perform the function of an arbitrator in technical cases. The parties to such disputes are always anxious to secure the attendance of an engineer who has reached a position of considerable eminence in his profession; but they do not seem to realise that if an engineer of distinction is retained, his remuneration must be commensurate with the position to which he has attained through long years of laborious study and research. In a case which recently came before the Court of Appeal, the question as to the amount of the fee for an arbitrator who hears a case under the Lands Clauses Acts was incidentally raised. It appeared that an Urban District Council sought to take land compulsorily from a water company. The purchase price was to be settled by arbitration. Each party appointed an arbitrator, and the arbitrators appointed an umpire. All three members of the court were engineers of distinction. After a hearing which lasted several days, the water company took up the award, in which the purchase price was fixed at £13,820, while the total fees charged by the arbitrators and the umpire came to £476 12s. The company objected to paying this sum, on the ground that it was excessive, and on taxation of costs as between the company and the District Council, the taxing master requested the engineers to show how the item was made up. This they refused to do, on the ground that "it was not consistent with the dignity of a Court of Arbitration to furnish particulars of their fees to the taxing master." It transpired, however, that each member of the court had charged 25 guineas a day, and that the umpire had been put to additional trouble in paying a visit to the *locus in quo*. There had been no prior agreement as to the amount of fees. In an action brought by the company to recover from the engineers the sum of £119 5s. (which had been taxed off the bill by the taxing master), Mr. Justice Ridley was of opinion that the fees were excessive, and allowed the plaintiffs £102 7s. 6d. The Court of Appeal, however, have reversed this judgment, and have allowed the engineers to retain the full amount, on the ground that their charges were similar to those which they would have charged had a previous agreement been entered into; and, further, because the plaintiffs must be taken to have known, when they entered upon the arbitration, and selected the members of the tribunal, that substantial fees would be charged.

This decision is eminently satisfactory to the engineering profession. Anyone who has had any experience of a "reference," will easily appreciate the labour which careful and exhaustive inquiry involves to the members of the court. But in employing those who have an assured position in the engineering world, the parties to an arbitration obtain more than a careful hearing. They obtain an opinion which carries weight. Just as the opinion of a general practitioner may coincide with that of a Harley Street specialist, so the valuation of a junior engineer may be the same as that of one who has reached the top of the tree. Nevertheless, the one will carry weight while the other will not.

The National Position of Steam Coal.

Prof. Boyd Dawkins recently wrote in advocacy of nationalising the steam coal seams of South Wales, which are now being exploited very largely for the benefit of the foreigner, who relies on Welsh steam coal in at least the earlier stages of a war, even if it were with ourselves. The Professor says that the supply of steam coal is very limited, and will last but a short time at the present reckless rate of consumption. The *Colliery Guardian*, which is the journal of the coal trade, altogether disagrees with the eminent geologist, but we can assure our contemporary that many minds at present are turned to the question of the coal supply, and though it might work hardships to many miners and others, there is a strong opinion that coal exports should be heavily taxed. By taxing coal even 1s. per ton, our contemporary appears able to draw weird pictures of what the Germans are doing to displace English coal in France. If the foreigner wants so much of our coal, the inference is that he would be less able to compete with us in manufactures than he is at present, but we do not ourselves wish in any way to regard the coal question as a fiscal question. It is more vitally national than that. In 300 years the present visible and suspected supplies of coal in this country may be absolutely exhausted at the present rate of consumption down to 4,000 ft. of depth, beyond which there is no present evidence that we can carry our mines.

Our contemporary talks about the disturbance of the labour market, and says that the progress of improvements in boiler furnaces will enable either oil or anthracite to be used. As to the latter, this will all be gone in the 300 years named, and as to oil, its use is perfectly possible to-day without furnace improvements; but there is so little of it. In respect of the pious hope that coal furnaces will improve, there is no improvement in extended use above the practice of 100 years ago; of what use oil will be to us when we have none in this country it is difficult to say. We should be dependent upon the foreigner for our fuel more than he is dependent upon us to-day. Does our contemporary think that before our best Welsh has departed the British Lion will be lying down amicably with the young and tender German lamb? A writer in a contemporary refers to the huge deposits of anthracite *below* the carboniferous limestone, and this alone is sufficient to make one pause before accepting his authority in preference to that of Prof. Dawkins. The coal supply of these islands is limited, and the wild statements so often made as to their inexhaustibility are simply an indication of the wish.

The coal of the United States is not unlimited, and if coal is to do for the world what it has done for us, then is the future with the yellow man. Our coal barons are reaping huge fortunes out of their coal fields. Yet, we believe, there is no evidence that rights in minerals can accrue to the owner, or supposed owner, of land acquired for agricultural purposes only, as all the big estates have been. The "coal owners" think not of the welfare of the nation in the way they deal with coal. They grumble at a modest tax of a shilling a ton, but have no qualms when it comes to raising the price of coal 5, 10 or even 15 shillings per ton to the British, and selling cheap to the foreigner. Coal is, and ought to be, a purely national asset. The land question is a broad one, but the most inveterate land-grabber would scarcely have the effrontery to claim that property in coal could fairly accrue to a mere agricultural leasehold. Yet it has been made to do, and the evidence before the Royal Commission shows how enormous are the values of coal wilfully put to waste during mining operations in order that the maximum of profit shall be earned in the minimum of time.

The coal resources of the country have been shamefully misused. Many valuable seams have been sacrificed to the greed of maximum profit. These lost areas are not even known in many mines, and few great industries have been worse engineered than that of coal mining.

THE ADVANTAGES OF BOOSTING.

By FRANK BROADBENT, M.I.E.E.

In one of his entertaining accounts of his tramps abroad, Mark Twain tells us that in climbing the Pyramids he was boosted up from behind by his dragoman.

The term "boosting," when applied to electrical matters, is generally used to express the raising of the line pressure to a higher pressure; that is to say, that when the voltage is boosted, it is given a lift to a higher level.

The paper read recently before the Institution of Electrical Engineers, descriptive of the City and South London Electric Railways, reminds us that boosting may be employed as effectively, and as satisfactorily, in lowering, as in raising, line pressures. Apart entirely from central station work, one of the most common uses to which boosting may be put is in charging accumulators. One very frequently comes across instances in which motor-transformers are used for

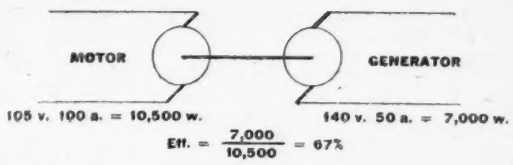


Fig. 1.

this purpose, whereas motor-boosters would be cheaper in initial cost, and more efficient in working. To take a simple case. Assume an installation running at 100 volts on the lamps and employing a battery of, say, 300 ampere-hours, taking a normal charging current of 50 amperes. Now let us consider the two methods of charging a battery, namely, (1) by a motor-transformer running off the 105-volt circuit, and (2) by a motor-booster. Fig. 1 shows the general arrangement of the motor-generator.

The generator must deliver 140 volts 50 amperes = 7,000 watts; assuming an efficiency of 82 per cent. for each machine, the combined efficiency is approximately 67 per cent. The motor, therefore, will absorb 100 amperes at 105 volts, 105 being the switchboard pressure. The loss in watts is about 3,500 out of the 10,500 delivered to the motor. The cost of the combined machines would be approximately £150.

Now, to take the second case, the connections would be as shown diagrammatically in fig. 2. In this case the generator has to pass 50 amperes, raising it 35 volts, which is equivalent to an output of 1,750 watts. The efficiency of

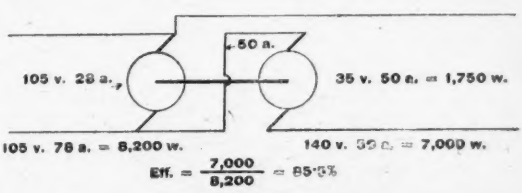


Fig. 2.

a machine of this size may be taken as 76 per cent., giving a combined efficiency of the motor-booster set of 60 per cent. The motor, therefore, would absorb 105 volts 28 amperes, the loss of power being 1,200 watts, as against 3,500 in the first case.

The current in the line from the generator or supply terminals would, under these conditions, be 105 volts 78 amperes, of which 50 pass through the booster armature with practically no loss, and 28 pass through the motor armature. Thus the only part of the energy transformed is that represented by 105 volts 28 amperes, rather more than one-fourth of that transformed in the first case.

The cost of the combined motor-booster would, in this case, be £75, or half the cost of the motor-generator in the first arrangement. More than this, only 78 amperes would be drawn from the line, or dynamo, and this, in a self-contained installation, means a considerable margin for other

purposes. The combined efficiency of the transformation, that is, the ratio between the output, 140 volts and 50 amperes, and the input of 105 volts 78 amperes, is 85½ per cent., as against 67 per cent. in the first case.

This saving may amount to quite a considerable sum in the course of a year. Thus, to take an extreme case, in which the battery requires to be fully charged every day, the generator would give 50 amperes for 7 hours, and the saving of energy in the booster arrangement would

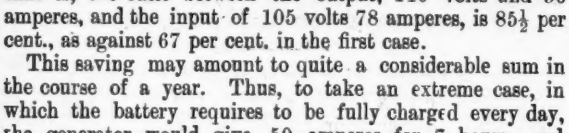


Fig. 3.

be 2·3 units per hour as compared with the motor-transformer. At 3d. per unit, this means a saving of 4s. a day, or, say, £73 a year, representing at 5 per cent. a capital sum of £1,460. Obviously, if the battery were charged on alternate days only, the saving would be half, and so on. This is an example of a small set, but it is quite a common size.

For a private installation, neither a motor-booster nor generator is essential, but in cases such as a large works or mill, from which the owner's private residence is supplied, or in which an accumulator is used for the office, or overtime lights, the arrangement is by no means an unusual one.

Now, look at the matter from another point of view. If the motor-generator had been installed to do the above work, namely, to charge at 140 volts 50 amperes, the machine could, by merely re-winding the generator armature, be made to give 200 amperes at 35 volts; and so, a battery taking this current could be charged without increasing the size of machine. The current on the 105-volt side would then be 300 amperes, of which 100 would go through the motor armature and the 200 through the booster armature (see fig. 3). Although the output is quadrupled, the loss is only 3,500 watts, as in the first case, and the actual efficiency of transformation is 89 per cent. So much for boosting upwards.

Cases occasionally arise in which it is desirable to reduce the line pressure. An installation may be running at 110 volts from its own generating plant, and it is desired to occasionally run it from the town supply at 400 volts. There are many such cases.

The usual method is to install a motor-generator, running the motor on the 400-volt mains, the generator delivering current at 110 to the motors or lights. To take an actual case. The generator is designed for 110 volts 270 amperes, or, say, 29,700 watts. The combined efficiency of the two machines is 80 per cent., giving an input to the motor of 400 volts 92·5 amperes, or approximately, 37,000 watts. The conditions are represented by fig. 4.

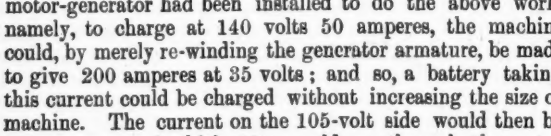


Fig. 4.

Last year this machine took from the mains 50,000 units, the difference in the readings of the meters on the supply and the generator sides being 12,500 units. This shows a loss of 25 per cent., as the machine does not run always at full load.

The loss at 2d. per unit means £104 annually. The cost of such a motor-generator as this would be approximately, £320. Now, suppose a reducing booster be used. In order to get the same current, namely, 270 amperes, in the motors and lights, we might use a machine of nearly half the size, the two armatures being joined right across the mains. The motor armature would absorb 300 volts 85 amperes, say, 25,500 watts, and the generator armature would develop 110 volts 185 amperes, the sum of the two currents, namely, 185 + 85, going into the low tension side. The efficiency of the transformation in this case, that is, the relation between the energy delivered to the circuit and that absorbed from the mains, namely, 400 volts 85 amperes, is approximately 87½ per cent., or 7½ per cent. more than the preceding case. Assuming that the same number of units are delivered as before, namely, about 37,500, at an average efficiency of 82½ per cent., the units paid for would be about 45,500, or a loss of only 8,000. The cost of this loss at 2d. per unit would be £66 10s. per annum, instead of £104 as in the previous case.

Fig. 5 shows the current and voltage in the various circuits. The cost of the machines in this case would be about £220, as against £330 for the motor-transformer. Looked at from the other point of view, namely, of keeping

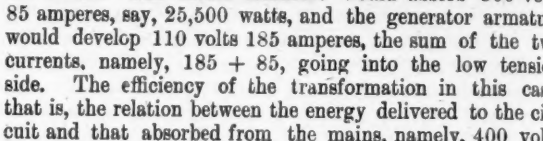


Fig. 5.

the machine the same size, the increased output that might be got by rewinding the motor armature is about 45 per cent. The armature would be wound for 300 volts, 123 amperes, the two armatures being put in series across the 400-volt circuit. The generator would give, as before, 110 volts 270 amperes, the sum of the two currents, namely, 393, being delivered to the circuit. The efficiency of transformation would, in this case, be about 88 per cent. Assuming that the energy used would be increased in the

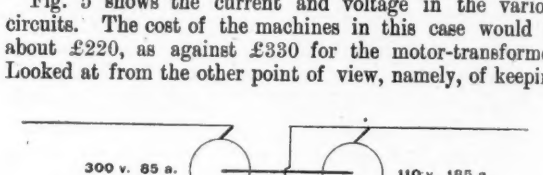


Fig. 6.

same proportion, we should get 54,500 units, and with an efficiency of 83 per cent., the loss would be 11,000 units, or less than in the first case, although we are getting 45 per cent. more out of the machines. Or, to put it another way, we get 45 per cent. more from the machines with an increased consumption of 30 per cent., and at the cost of rewinding one armature only.

Fig. 6 shows the currents in the various circuits in the last case considered.

INSTITUTION OF ELECTRICAL ENGINEERS.

MANCHESTER CORPORATION TRAMWAYS.

The Permanent Way, Overhead Equipment, and Rolling Stock.

By J. M. McElroy.

(*Abstract of Paper read at Manchester, February 16th*, 1904.)

It is nearly thirty years since the first line of tramways was laid in Manchester. In those days the Corporations of Manchester and Salford agreed to join together on matters connected with tramways, and they constructed a line which began in Salford and ended in Salford. Each Corporation constructed the length within its own district.

Permanent Way.—The portion of the line in Manchester was constructed on a principle invented and patented by Benjamin Barker, a foreman platelayer in the service of the well-known tramway engineer, Mr. Joseph Kincaid.

The Barker rail did not prove a success, and when the Manchester Corporation determined to construct a general system of tramways throughout the city in the years 1879 and 1880, they

decided to adopt what was then, and is still, described as the girder rail.

The adoption by the Corporation of a girder rail weighing 98 lbs. to the yard so far back as the year 1879 is interesting. No less than 34 different types of rails were submitted for the Corporation's consideration. Eventually the girder rail patented by Mr. Gowans was selected, and the Corporation paid the modest sum of £500 for the licence to use it. The soundness of the Corporation's judgment in this matter is established by the fact that girder rails are now almost universally used for the construction of tramways.

When the lease of the lines to the tramways company was coming to an end, and the question of the introduction of mechanical traction was under consideration, a thorough examination of the whole of the track was made, and a report was presented to the Corporation showing clearly that not only were the rails too far worn, but the joints were not nearly strong enough for mechanical traction. The Corporation thereupon determined to reconstruct the permanent way of the entire system, and the work has been carried out by the m v ı y department's own staff.

The new section of rail, adopted for the work, weighs 102 lbs. to the yard; it is 7 in. deep, with a base 7 in. wide, and a groove $1\frac{1}{8}$ in. wide, and is rolled into 60-ft. lengths.

Although the new section weighs only 4 lbs. per yard more than the old section, it is superior from every point of view. It has a wider tread, a wider and deeper groove, and, what is most essential, shoulders which give a good bearing for the fish-plates. The fish-plates are 24 in. long and $\frac{7}{8}$ in. thick, and are pierced for the reception of six bolts.

In our rail specification we call for the usual drop and tensile tests, and we require, as is necessary nowadays for mechanical traction, rails with a high percentage of carbon. We specify not less than ·50 nor more than ·65 per cent.

For our curve track we use rails with a $1\frac{1}{4}$ in. groove and a guard 1 in. wide. On sharp curves the groove soon wears to $1\frac{1}{2}$ in. and $1\frac{3}{4}$ in. The wheel flanges wear away the guard of the rail very rapidly.

The road bed in most of our main thoroughfares is exceptionally good, and all that we found it necessary to do was to lay a concrete bed 18 in. wide and 6 in. deep under the rails, and this has proved quite satisfactory.

We laid the rails direct on the concrete bed, and packed them well with chippings and cement packing, grouting the bed afterwards.

The straight track rails are tied to gauge every 10 ft. by tie bars. On curves the tie bars are placed closer.

The paving between the rails and for the 18 in. margins has—with one or two exceptions—been laid with 6 in. Welsh granite setts.

The paving has been grouted with pitch grouting. This grouting is undoubtedly the best if the work is carried out in fine weather, but in wet weather it is somewhat defective. Under the conditions, however, which prevailed in Manchester—where the traffic was allowed to run over the track almost immediately it was laid—cement grouting was quite out of the question.

When we began the reconstruction work the most difficult problem we had to face was how to re-lay the most important junctions in the city without causing serious public inconvenience. At the time I speak of no firm in this country were in a position to undertake this work, and consequently orders to the extent of £80,000 were placed by the Manchester Corporation in America. One or two British firms are now in a position to undertake this class of work, and we have placed some orders with them.

The laying of all the important junctions in the city was done on Saturday nights and Sundays. The work at each junction was commenced at, say, 11.30 on Saturday night—after the last car had gone—and by six o'clock on Sunday evening the whole of the junction was laid and paved up. Very few citizens were aware of what was going on, and the public inconvenience was reduced to a minimum.

All the curves at the junctions and elsewhere are spiralised, thus ensuring easy running of the cars. The points and crossings are provided with hardened steel renewable centres.

Each joint has been bonded by two copper bonds fixed *over* the fish-plate and one copper bond *under* the fish-plate, *i.e.*, between the fish-plate and the web of the rail. The bonds are of the ordinary "Chicago" and "Crown" types.

Our experience in regard to the track since it has been reconstructed may prove of some interest. The wear and tear of the rails, especially at junctions, is very great. Our estimate of the average life of the track is 10 years. In arriving at this estimate we include all roads—those of light as well as those of heavy traffic.

We have had some little trouble, in common with other towns, with the setts rising at the sides of the rails on a few routes. The remedy is to anchor the rails or to use a deeper rail. Personally, I favour the adoption of a 9-in. rail. A rail of this depth could be embedded in concrete to the extent of 2 in. to $2\frac{1}{2}$ in., and this would prevent any "creeping" or movement of the rail, which is the cause of the setts lifting.

The life of the rails is measured by the life of the joints. The fish joint adopted in Manchester—where the rails are butted up close and no expansion joints allowed—is as satisfactory as a built-up joint can be made, but recently we have been looking into the question of so-called "continuous" rail joints.

The Overhead Equipment.—The overhead equipment is almost entirely span-wire construction with side poles. Our experience is that, except for very wide roads, the span-wire system is the best. The objection to centre poles is not urged from a tramway point of view. Those who use the streets for ordinary vehicular traffic maintain that centre poles form an obstruction, and that they transform a good street into two bad ones.

The side poles are of mild steel, built up in three sections, 31 ft. long when complete. The usual deflection and drop tests are called for in our specifications.

The trolley wire is of hard drawn copper, ·4 in. in diameter. All trolley wire used in our work is carefully tested for conductivity and breaking stress.

The span wire is galvanised steel stranded wire, $\frac{7}{16}$ S.W.G.

We have adopted triple insulation throughout the whole of our overhead construction, namely, an insulator bolt at each ear, with globe strains, and Brooklyn strains at each span-wire terminal. We have used gun-metal for all the metal parts, and have paid special attention to the tensile test when the goods have been received.

The frogs are of the movable type, worked by the point boys. We have tried several types of automatic frogs, but have not so far found any suitable for our system. The section insulators—which are, of course, the weak spots in the line—are carefully anchored.

Guard wires have been erected in compliance with the Board of Trade regulations. These are a source of trouble to us, but, happily, the Corporation has recently come to an agreement with the National Telephone Co., and the result is that all telephone wires—except the Post Office wires—are being placed underground, and most of the guard wires will, therefore, in a short time find their way to the scrap heap.

The Rolling Stock.—We have three types of cars at present in service. The first type is a double-deck single-truck car, seating 45 passengers, and weighing, when empty, about 8 tons, and when fully loaded a little over 11 tons. The second type is a double-deck double-truck car, seating 71 passengers, and weighing, when empty, slightly under 11 tons, and when fully loaded, about $15\frac{3}{4}$ tons. The third type is a single-deck double-truck car, seating 48 passengers, and weighing, when empty, slightly over 11 tons, and, when fully loaded, about $14\frac{1}{2}$ tons.

The first type—the small double-deck cars—we use on most routes for what we call our "all day" services. The second type—the large double-deck "bogie cars"—we use mainly for "part day" services, that is, the extra services we put on at the "rush hours." The third type—the single-deck cars—were obtained for use on the circular route on which the bridges are too low for double-deck cars.

Before actually fixing upon any special type or types, the Corporation had a number of sample cars built, differing in detail as regards their construction, and the types finally determined upon are an embodiment of the best points chosen from each of the samples. The general design and many details of construction were original. We did not copy from other places, and we did not adopt what the car builders desired to sell—*i.e.*, their stock designs.

We have a wider rocker and a narrower waist panel than is usual. This, we think, gives the cars a neater appearance than they would otherwise have.

We have not adopted the reversed stairway, which is now in common use on cars in other towns. Our main objections to it are two:—First, it obscures to some extent the motorman's view, and prevents his obtaining the fullest possible view of the road and side streets, and, secondly, it forms an obstruction to passengers coming into and leaving the car, the outside passengers being jammed against the inside passengers.

The roof is of the monitor type. We prefer this roof to the flat one now generally adopted, inasmuch as we consider it stronger and more durable.

The car bodies are strongly built. We had an inspector practically living with them during the whole time they were under construction, and we are perfectly satisfied we got what we specified.

The trucks for the small cars are of two well-known types—Brill and Peckham.

The bogie trucks are of the maximum traction type. In some, we have the pony wheels leading; in others we have the driving wheels leading. We prefer the latter. When the pony wheels lead there is a tendency for the truck to leave the track at curves. We have had trouble with bogie cars coming off the track. One of the principal causes has been a defect in the points. When the pin at the heel of the points becomes loose and the front bogie passes over it, there is a tendency for the toe of the point to be moved from its position before the hind bogie reaches it, and, if this occurs, the hind bogie takes the wrong track. We are, however, remedying this defect in the points by an apparatus which will hold the points at the toe. Generally speaking, our experience of maximum traction trucks—used as they are in a city with no severe gradients—is not at all unfavourable.

The wheel base of our single trucks is 5 ft. 6 in. This is 6 in. less than is usual in other towns. Our reason for adopting this length of wheel base is the shortness of the radii of some of our curves. The minimum radius is 35 ft., measured from the track centre line. The wheel base of the bogie trucks is 4 ft.

All the wheels we have used, until recently, have been chilled cast-iron. During the past few months, however, we have been experimenting with steel-tired wheels, and these have given very good results. In America nothing else but chilled cast-iron wheels are used, but on the Continent chilled wheels have been given up, and steel tires have taken their place.

Our little experience with steel tires leads us to think that we shall find them much more satisfactory for our system than chilled wheels. We get a far greater mileage out of them, we get better "braking" effect, and we get no "flats" on the wheels. The putting of "flats" on wheels in a large system like ours is a serious and annoying matter. They are, of course, in most cases, caused by careless motormen. We find, however, very great difficulty in putting our hands on the men who are to blame. Wheel "flats" are a great annoyance to the travelling public, and more particularly to the residents along the lines of route.

The depth of the wheel flange is $\frac{1}{2}$ in., and the wheels are

pressed on the axles so as to allow ½-in. clearance over the track gauge. There is a clearance between the bottom of the wheel flange and the bottom of the rail groove, on new rails, of ⅝ in., thus allowing the head of the rails to wear down to the extent of ⅝ths of an inch before the wheel flange touches the bottom of the groove. When the latter event happens, we consider the rails require renewing.

The car equipments are of two well-known types—the British Thomson-Houston and the Dick, Kerr. We have 305 cars equipped with the former, and 137 with the latter.

Each small car is furnished with two 25-H.P. motors, and each bogie car with two 35-H.P. motors. They are single reduction four-pole motors, enclosed in strong water and dust-proof steel frames.

In our specifications we stipulate for the usual insulation and efficiency tests. We demand an efficiency of 82 per cent.

The controllers are of the ordinary series-parallel type.

The trolley standards are of the internal spring type, and are fixed 15 in. from the longitudinal centre line of the car. The trolley heads are of the swivelling type and are provided with a spring which keeps the wheel in line with the boom.

The panorama destination indicators, which we are now adopting for all our cars, contain the names of 30 different routes, so that each car in the sheds may be turned on to any route.

We adopted, at the commencement of our system, what is termed the "cow-catcher" lifeguard, and the statistics show that it has been, on the whole, successful in its operation. It has saved a number of persons who have been knocked down by the cars from getting under the wheels, by pushing them on one side clear of the track. In one or two instances it has failed, but the percentage of successes showed that it was by no means an unreliable guard. In compliance, however, with the wishes of the Board of Trade we have discarded the "cow-catcher" in favour of the "swinging-gate" or "trigger" lifeguard, which is now used on almost all the tramway systems in the country. In most instances where persons are knocked down and killed by cars the lifeguard is not called into service at all, the persons being fatally injured, generally on the head, by being thrown on to the hard pavement.

The best life-guard is a good brake. Our cars are equipped with the ordinary hand-brakes and rheostatic brakes, which answer their purpose very well.

Manchester is a flat city. We have very few steep grades. On the Stockport route, where we have the worst gradient, we run cars equipped with the Westinghouse magnetic track brake.

We have experimented with mechanical and pneumatic track brakes, and there are many good points in favour of each type.

In the electrical engineering and tramway field there are inventors *ad infinitum*. But the torment of a tramway manager's life is the "dry seat" inventor. The press has led him to believe that there is a fortune waiting for him, and he draws the conclusion that the only obstacle between him and £50,000 is the tramway manager, who won't recommend the adoption of his invention. I have thrown cold water on a great many patent seats, but they never dry up—I mean the inventors.

We are equipping 100 cars with "dry" seats of the thin lath type. This seems to be the best in the market, taking all points into consideration. The only way, however, to induce passengers to ride outside in wet and inclement weather is to cover the tops of the cars. We are fitting up some cars with top covers as an experiment. We have, however, several low bridges to contend with.

THE DEMI-CAR AND REGENERATIVE CONTROL.

The development of the "One-man car" or "Demi-car" provides an excellent illustration of the manner in which one invention grows out of another. The regenerative control was designed to reduce the ruinous cost of "Corporation electricity" on lines with severe gradients, but no sooner was it put in operation than it became evident that the new system relieved the driver of nine-tenths of his work.

One of the Board of Trade inspectors said: "You must now invent something to keep the driver awake." The answer was: "The One-Man car." On this car the driver looks after the passengers and takes their fares; in fact, he performs the duties of both driver and conductor. The car itself is only half the weight of an ordinary car, and requires only half the power to drive it; in fact, all the working expenses are divided by two. The result is that lines which at present can support only a 20 minutes' service can support a 10 minutes' service of demi-cars, and take more than double money; in other instances a 10 minutes' service can be raised to five minutes. There are many lines in this country which pay only 2 or 3 per cent., and where there is not sufficient traffic to support an efficient service of ordinary cars.

Suppose a line is earning 6d. per car-mile, and the working expenses are 5d.—net profit 1d.

Substitute demi-cars and we get this result:—Takings, 6d.; expenses, 2½d.; profit, 3½d. The net result is improved at least three times. On an ordinarily good tramway the takings average 11d. and the expenses about 5d., but there are certain times of the day, usually in the forenoon, and in some districts two or three days a week, when the takings do not exceed 4d. a mile; therefore, on every journey under such conditions, there is a loss of 1d. a mile, which has to be made good out of the profits earned at other times.

This is where the demi-car comes in; it converts the loss of 1d. into a profit of 1½d.; the financial position is, therefore, 2½d. better.

The question at once arises—will it pay a prosperous company to use demi-cars? Assume that such a company has an annual car-mileage of 450,000, with average takings 10d., and working expenses 5d. The 450,000 car-miles are divided into 150,000 at 4d. and 300,000 at 13d.

The net profit works out thus:—

300,000 miles at	(13 − 5)	= + 2,400,000d.
150,000 „	(4 − 5)	= − 150,000d.
		2,250,000d. = £9,375.

With demi-cars during the slack hours, the net profit works out thus:—

300,000 miles at	(13 − 5)	= + 2,400,000d.
150,000 „	(4 − 2½)	= + 225,000d.
		2,625,000d. = £10,937.

The difference—£1,562—is more than sufficient to pay interest and depreciation on the additional capital required, and to materially increase the dividends.

The construction of the cars was described and illustrated in our issue of September 25th, 1903. The enclosed body provides seats for 14, and there are two external smoking compartments with three seats and standing room for six. The passengers enter on the left-hand side of the driver, the rear entrance being closed, and the step turned up.

The safety of the passengers is ensured by the pay-gate, which is coupled to the controller in such a manner that the car cannot be started until the gate is closed; in case of necessity a passenger may lift the gate and stop the car. It is in consideration of these provisions for the safety of the public that the Board of Trade has approved the car.

The Southport demi-car has now been running several months. Its consumption of energy is 0·28 unit per mile, whereas the large cars of the company take 0·55, similar motors being used in both, one on each car.

The advent of the demi-car ought to give a great impetus to the development of electric tramways, both by improving dividends and by making electric tramways possible in districts which, under existing conditions, could not support them.

NOTES ON THE CURTIS TURBINE.*

By F. SAMUELSON.

An inherent difficulty with steam turbines is to efficiently use the very high velocity which steam imparts to itself when expanding.

Steam expanding from 150 lbs. pressure per square inch to 28 in. vacuum, attains a velocity of about 4,000 ft. per second. The velocity of water discharged from a nozzle with 100 ft. head is about 80 ft. per second. These figures illustrate the radical difference of conditions between steam and water turbines.

Before the appearance of the subject of this paper, two turbines in particular, amongst others, were brought out, viz., the Parsons and the De Laval, and great credit is due to those eminent inventors.

In the De Laval turbine, the energy of the steam is converted into kinetic energy through an expanding nozzle. The jet so produced is delivered against a set of vanes or buckets on a single wheel, which by an ingenious construction and method of suspension is adapted to operate at a very high peripheral velocity.

In the Parsons turbine the steam is carried in an axial direction through the space provided between a succession of internal revolving cylinders and external stationary cylinders which enclose them. In passing through this turbine, the steam never acquires a speed which approaches the velocity which it attains in the De Laval nozzle, but instead moves along, alternately acquiring velocity by expansion and partially giving it up by impact with the moving vanes.

The Curtis turbine retains some of the features of its predecessors, but embodies new ideas, which make possible a lower speed, fewer and simpler parts, good economy, low cost and other important advantages.

It is of the "impact" type, in which the torque is a maximum at standstill, and zero when the velocity of the wheels is the same as the velocity of the steam jet, thus giving a maximum output and best economy when the torque is one-half the maximum and the velocity of the wheel is one-half the velocity of the steam.

Dry saturated steam acquires a velocity of about 2,900 ft. when expanding from a pressure of 150 lbs. to the atmospheric pressure; and expanding from the same boiler pressure to 28 in. vacuum or 2 in. of mercury back pressure, it acquires a velocity of about 4,000 ft. per second. Since energy is equal to $\frac{w \times v^2}{2g}$, we get in the first case 135,000 ft.-lbs. per lb. of steam, and in the second case 251,000 ft.-lbs., from which it will be seen that only about one-half of the available energy of the steam is taken out when expanding to the atmospheric pressure. As 1 KW.-hour is equal to 2,660,000 ft.-lbs., we should theoretically require 10·6 lbs. of steam

* Abstract of Paper read before the Rugby Engineering Society on November 5th, 1903.

per KW.-hour. If the turbine actually requires 20 lbs. of steam per KW.-hour when running condensing under the above conditions, we recover 53 per cent. of the energy available in the steam.

20 lbs. per kilowatt-hour at the generator terminals may fairly be estimated as equal to 13 lbs. per I.H.P., which is not an unusual figure in steam consumption guarantees of large engines. The remaining 47 per cent. of the available energy is a loss. There is no doubt but that we shall have to look to the steam turbine to materially reduce this loss, as it is particularly suited to operate under high pressures and with high superheat, which two conditions are conducive to good economy.

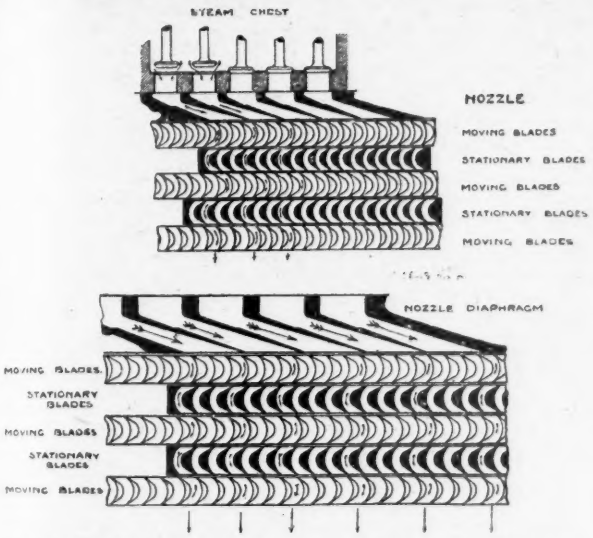


Diagram of Nozzles and Buckets in the Curtis Steam Turbine.

The general features of the Curtis turbine may be briefly described as follows:—

Velocity is imparted to the steam in an expanding nozzle so designed as to effectively convert into kinetic energy the expansive force of the steam between the pressure limits used. After leaving the nozzle, the steam passes successively through two or more lines of buckets on the moving element, which are placed alternately with reversed buckets on the stationary part of the turbine. Thus, the steam is first thrown against the first set of buckets on the moving element, and then re-directed against the second moving set of buckets by passing through the first set of the fixed buckets, rebounding alternately from stationary to movable buckets, until the steam is brought to rest.

By this means, a high steam velocity is made to efficiently impart motion to a comparatively slowly moving element.

The nozzle is generally made up of many sections or units adjacent to each other, so that the steam passes to the buckets in a broad belt when all the sections are open.

This process of expansion in the nozzle, and subsequent abstraction of velocity by successive impacts with the buckets, is generally repeated two or more times, the device for each repetition being generally designated as a stage. There are various numbers of stages and various numbers of lines of buckets in each stage. The number of stages and the number of lines of buckets in each stage are governed by the degree of expansion, the peripheral velocity of the buckets which is desirable or practicable, and by various conditions of mechanical expediency.

A steam-tight diaphragm is placed between each two stages, the only outlet for the steam passing to the next stage being through the nozzles in the diaphragm.

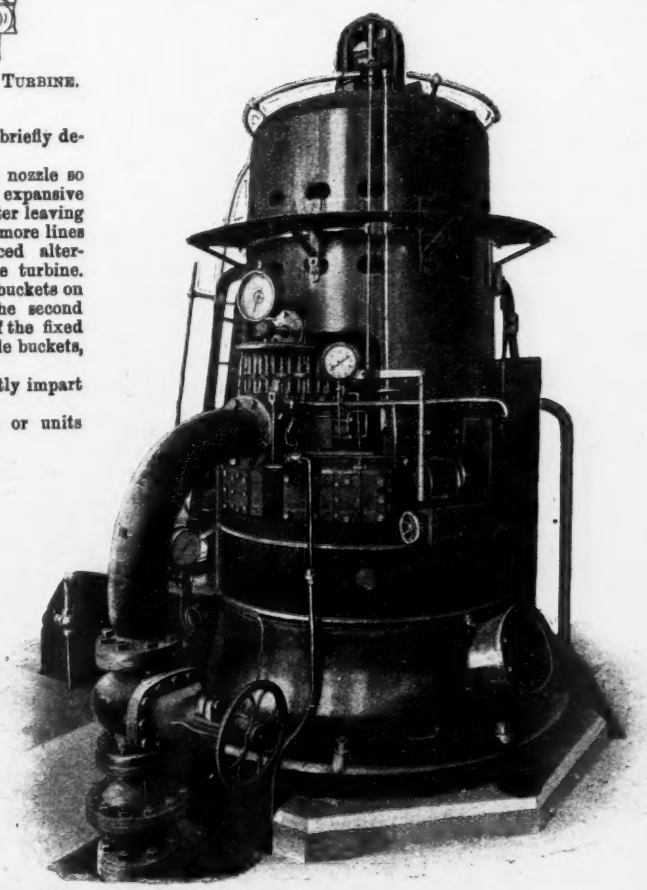
The leakages in the buckets are, therefore, not total losses, except in the last stage, as the steam has to pass through the nozzles in the succeeding diaphragms and do further work.

One of the boldest and most noticeable features in the Curtis turbine is the vertical shaft. This type of construction has been adopted for all sizes from 500 KW. upwards, and experience has thoroughly justified its use and demonstrated its desirability.

The use of a vertical shaft necessitates a foot-step bearing which is fixed to the bottom of the base, and removable from below, a pit or opening being provided in the foundation for this purpose. The bearing part proper, which supports the rotating elements of the turbine and generator, consists of two circular cast-iron plates, one being fixed to and rotating with the shaft, the other fixed to the base. Through a hole in the stationary plate oil is forced between the plates from the centre outwards in a thin film separating the two plates by about ·005 of an inch. From the foot step bearing the oil passes upwards and lubricates the guide bearing which is placed immediately above it. The oil is forced between the plates by a pressure pump designed to give approximately a constant pressure and a constant flow. The pressure required depends upon the weight of the rotating part and the area of the bearing blocks, and in a small degree upon the temperature of the oil. The thrust of the steam jets on the buckets is not noticeable, as the oil pressure required is exactly the same whether the turbine stands still or rotates. The oil pressure in the step bearing varies from 175 lbs. per sq. in. in the 500 KW., to about 900 lbs. in the 5,000 KW. turbine. Experiments have demonstrated that the minimum safe amount of oil required for the bearings per minute is from half a gallon for the 500 KW. to four gallons for the 5,000 KW. turbine. A small amount of this oil is shunted through a resistance and delivered to a tank placed above the level of the turbine. Oil flows by gravity from this tank to the upper and middle bearings, a sight-feed arrangement being introduced in each branch. The oil from all three bearings is returned to a common tank, where it is strained and cooled before being put in circulation again.

To prevent the turbine being run either by steam or through the generator acting as a motor before oil begins to flow in the step bearing, or in case the flow should cease while the turbine is working, an automatic oil-flow switch is placed in the high pressure oil supply pipe. This switch is actuated by the oil pressure, and opens and closes the electric circuit for the valve magnets in response to the changes of pressure in the pipe. If the flow of oil in the bearing falls below the pre-determined quantity or pressure, the switch opens the valve circuit, and all the valves close, immediately shutting off the steam from the turbine. When the switch opens, a special relay is closed, which trips the generator circuit-breaker, and prevents the generator from running as a motor and driving the turbine. The upper and middle bearings of the vertical shaft have no load to carry save that due to want of balance and to unbalanced magnetic pull in the generator.

All the bearings can be taken out without disturbing the turbine or generator. The foot-step blocks and the guide bearing are lowered into the pit below, the middle bearing is split, and can be removed sideways, and the upper bearing is lifted out, it being necessary to first remove the governor. As the step bearing works under atmospheric pressure, it is necessary to provide a packing round the shaft at this point to prevent air entering the exhaust base when the turbine is working under vacuum, or steam escaping when the shell pressure in the turbine is higher than the atmospheric pressure. For the same reason, packing is provided where the upper end of the shaft passes through the turbine cover.



500-KW. Curtis Turbine in the B.T.-H. Co.'s Rugby Power Station.

The 500-KW. turbine has three wheels or rows of movable buckets in each of the two stages. Each wheel consists of a solid steel disc with the buckets cut from the solid rim, and the three wheels are bolted to a common hub which fits the shaft. The total number of buckets on the wheels in this turbine is 1,395, a small number compared with other turbines.

The stationary buckets have approximately the same shape as the wheel buckets, and are fixed to the casing of the turbine. The number of stationary buckets is dependent on the number of

nozzles in the stage, as they need only cover the same periphery of the wheels as the nozzles do.

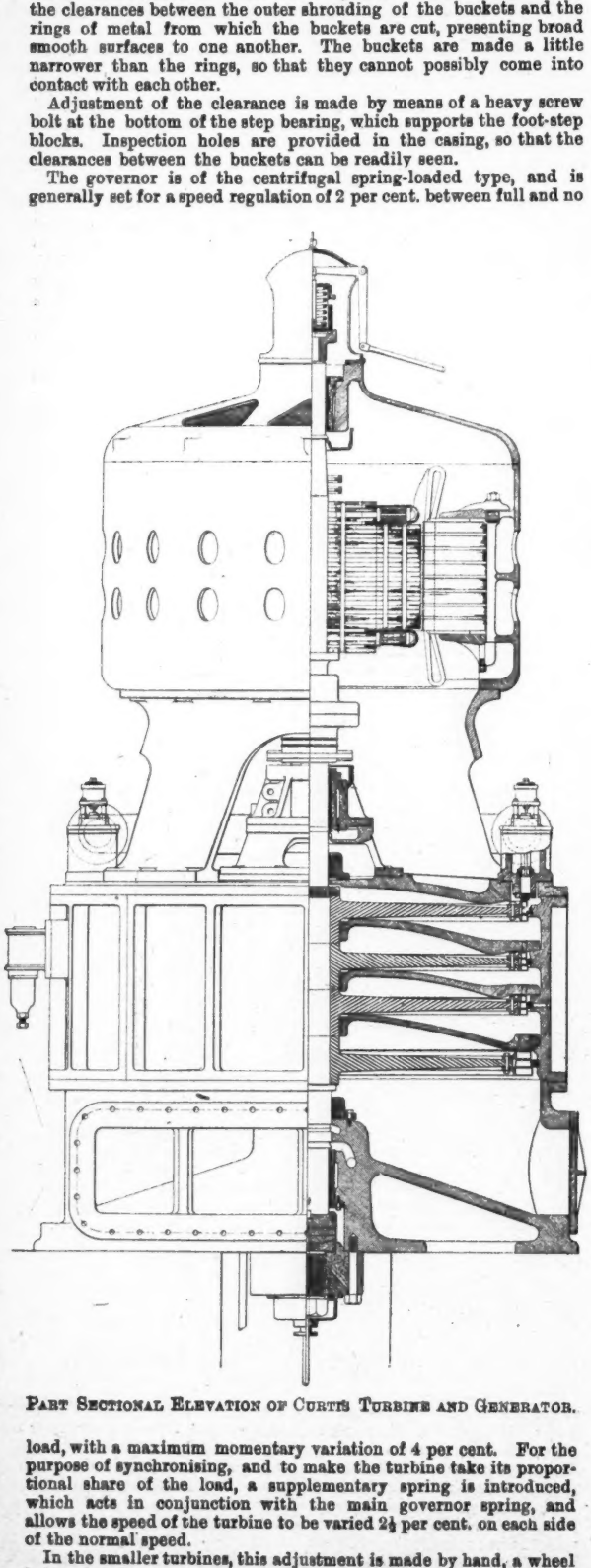
On account of the large increase in volume of the steam, and to keep the depth of the buckets as small as possible, the last stage wheels are completely surrounded by nozzles and stationary buckets.

In the later designs of the turbine, the construction of the wheels has been modified. Instead of using separate discs bolted together, a single cast-steel wheel is used with the bucket rings or segments bolted to the sides at the periphery of the wheel.

The clearances between stationary and rotating parts vary from ·02 in. in the small to ·08 in. in the 5,000-kw. turbine. These are the clearances between the outer shrouding of the buckets and the rings of metal from which the buckets are cut, presenting broad smooth surfaces to one another. The buckets are made a little narrower than the rings, so that they cannot possibly come into contact with each other.

Adjustment of the clearance is made by means of a heavy screw bolt at the bottom of the step bearing, which supports the foot-step blocks. Inspection holes are provided in the casing, so that the clearances between the buckets can be readily seen.

The governor is of the centrifugal spring-loaded type, and is generally set for a speed regulation of 2 per cent. between full and no load, with a maximum momentary variation of 4 per cent. For the purpose of synchronising, and to make the turbine take its proportional share of the load, a supplementary spring is introduced, which acts in conjunction with the main governor spring, and allows the speed of the turbine to be varied 2½ per cent. on each side of the normal speed.



Part Sectional Elevation of Curtis Turbine and Generator.

In the smaller turbines, this adjustment is made by hand, a wheel being placed in a convenient position near to the main throttle valve. In the larger turbines, from 1,500 kw. upwards, a small motor actuates this spring. The motor is controlled by a double-pole double-throw switch placed on the switchboard or at any other convenient position.

The governor operates a controller opening or closing the electrical circuits of magnets which operate pilot valves, these in turn admitting steam, or exhausting it from the spaces behind the pistons of the main valves, one of which is provided for each nozzle or group of nozzles, the governor thus opening and closing these valves, and varying the number of nozzles in service in proportion to the load.

Since each nozzle represents a comparatively large proportion of the whole power at light loads, one of these valves would be called upon to open and close alternately in rapid succession in order to hold the speed constant. To avoid this a balanced throttle valve is placed in series in the steam path of the first valve and corresponding nozzle, and so connected to the governor that it must be fully opened before the governor can open the next valve, and again fully closed before the controller moves backwards and closes the valve last opened. The result is that the turbine can run at a constant speed on any load, although only a small part of the whole steam flow is throttled. Thus the disadvantages of admitting steam in puffs with the consequent tendencies to variation in speed at light loads, making the parallel running of the generators difficult, or of throttling the whole steam flow, are avoided.

In the process of governing, the nozzles in the later stages are also, in some of the turbines, opened and closed, so as to maintain an adjustment of pressures proportional to that of the first stage, which is always the primary source of governing.

A sufficient number of nozzles are provided in the first stage to run the turbine at full load non-condensing. Hence the turbine has an overload capacity of about 100 per cent. when operating condensing with a 28 in. vacuum.

In addition to the speed regulating governor, which will always hold the no load speed of the turbines within about 2 per cent. of the full load speed, an emergency governor is provided whose function is to trip a trigger should the speed of the turbine increase 15 per cent. above normal, and thus permit a weight to fall and give a hammer blow to a butterfly or damper valve in the main steam pipe, closing the valve instantaneously. This governor is located on the shaft between the turbine and the generator, and consists of an ordinary centrifugal device balanced against a spring. The governor restores itself to normal position when the speed is reduced to normal, so that it is not necessary to stop the turbine, but the butterfly valve and weight must be brought to their normal position by hand. Such a precautionary device is rarely called upon to act, but experience with large engines has shown it to be desirable.

All the vertical turbines are so designed that the exhaust base, on which the turbine stands, can be replaced by a condenser base. Placing the condenser directly under the turbine makes a very compact and efficient arrangement. Its simplicity, saving in floor space and foundations are at once evident. A better vacuum is obtained due to reduction in air leakages and to the shorter and more direct path of the exhaust steam. It is safe to prophesy that most of the future turbines installed will be of the condenser base type.

The condensing types of the Curtis turbines are designed for a normal steam pressure of 150 lbs. and a vacuum of 28 in. or 93½ per cent. of the barometric pressure.

The steam pressure may be varied about 15 per cent. from normal without affecting the economy much. With the lower pressures, however, the overload may be reduced, as each nozzle discharges a fixed quantity of steam depending upon the pressure. As already indicated, the overload capacity is about 100 per cent., so that a reduction here of 15 to 20 per cent. of the turbine's capacity is not of very great importance, as long as the generators are designed for an overload of only 50 per cent. Any considerable excess of the normal pressure does not tend towards economical working, as the ratio of expansion of the nozzles is then too small to make available the additional energy due to the higher pressure, so that in general, when the pressures vary more than 15 per cent. from the normal, the design of the turbine will have to be adapted to suit the pressure.

(To be concluded.)

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week.

Radium: A Guess.

Your correspondent "J. C. R." has offered a suggestion with regard to radio-activity.

I should like to point out the objection that all hypotheses assuming that radio-active substance absorb unknown radiations are contrary to the experimental evidence going to show that such activity is not a permanent property of such substances. This point was discussed in a communication to *Nature* last year by Prof. J. J. Thomson.

William J. Williams.

February 20th, 1904.

Electricity in Mines.

I am pleased to see that the correspondence on electricity in mines and electric coal-cutters has attracted the attention of so many electrical engineers in charge of mining plant, as

the information contributed by them to your columns cannot but be very valuable to those who occupy similar positions.

The rough work, and still rougher handling, which electrical machinery must be able to withstand in mines, and the peculiar and varying conditions found underground, specialise to a great extent the work of the electrician in charge as compared with surface work, and the constantly increasing number of the ways in which electricity may be applied to mining must, in the near future, give an added importance to this branch of the profession.

In the past, colliery managers have been very conservative with respect to installing electrical machinery down their mines. This effect *may* have been contributed to by the differences of opinion amongst electrical engineers, but in a great measure it was due to the action of those managers who did adopt electricity, and who, under the impression that the need for skilled attention was slight, gave over the care of the plant to incompetent, and in most cases inexperienced, men.

The subsequent breakdowns, inevitable though they were under such conditions, went far to prejudice managers, on the look out for an economically transmitted motive power, against electricity.

Again, it is only recently that electrical manufacturers have realised that *special* appliances *must* be designed to meet underground conditions, and that upon a basis of safety combined with efficiency, a large and constantly increasing market for their goods will be opened to them.

Most colliery engineers will hail with delight the adoption of the code of rules recommended by the recent Inquiry Committee.

The effect will certainly be good, and anyone who knows anything about colliery installations will agree with me that there is considerable room for improvement in most of them.

With regard to coal-cutting machinery, I have no doubt that the hardest work and the most severe test of efficiency for an electric motor is embodied in the operation of the appliances for both cutting and holing coal.

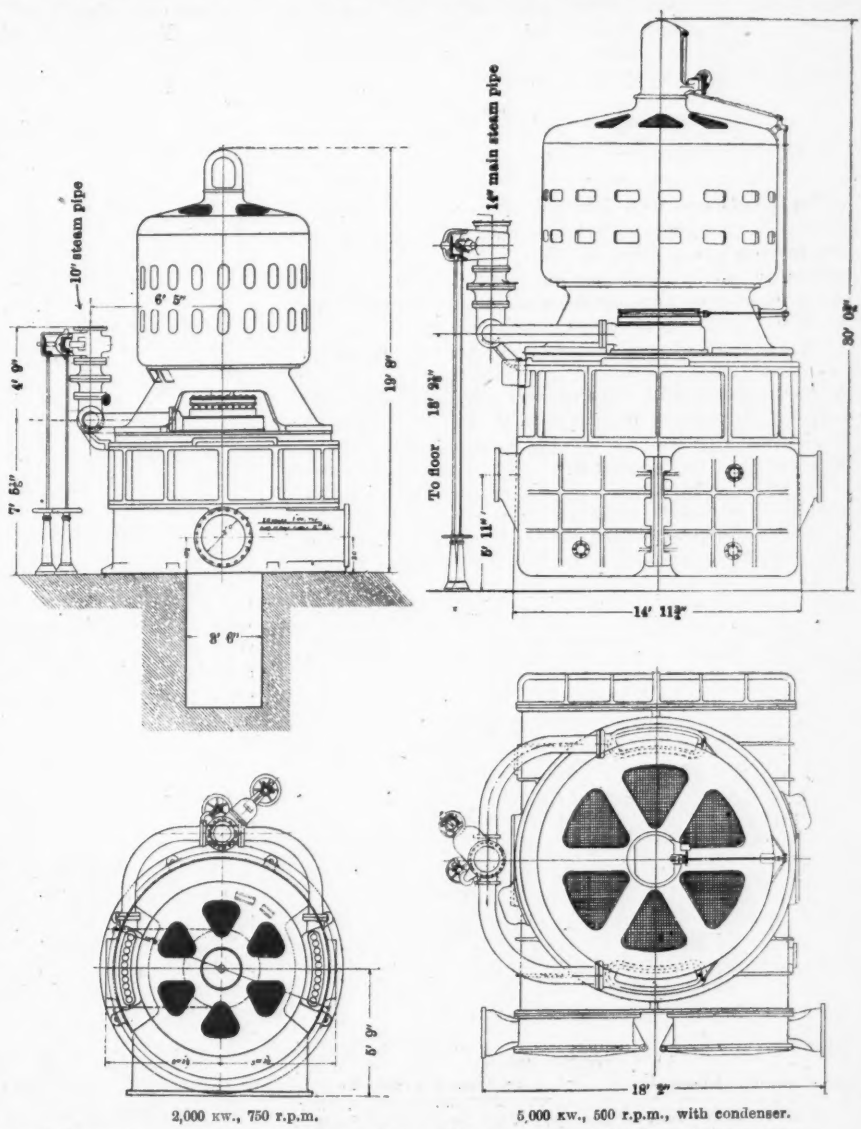
The installation of which I have charge is three-phase, and, of course, I have no trouble with commutators of coal-cutting motors, although having had charge of continuous current cutters, I can sympathise with those who have them to attend to. A great deal of hard work, however, may be saved if the example of my friend Mr. J. Bentham, whose letter appears in your Feb. 19th issue, be followed. What I fail to understand is, How did he get his drivers so well trained? I should be obliged for his recipe.

We have in use at our collieries the Hurd bar-holing machine, driven by a three-phase motor with short-circuited rotor. This is started through a three-phase auto-transformer to avoid the excessive starting current in the mains, and the switch is so designed that it is impossible to switch back on to the auto-starter when stopping the machine. This machine has holed 78 yards in nine hours, with frequent stoppages.

The holing is done in the dirt under the coals, and the bar brings out the holings, being supplied with a worm for that purpose.

I have had no trouble with this machine, chiefly on account of the strict daily inspection which I insist upon it receiving. Small faults are by this means discovered and remedied before they have time to build up into anything serious. The auto starter fulfils its duties admirably, the current taken from the mains at starting being not more than twice the full load current when the bar is under the coals.

A great deal has been said for and against the employment of high tension currents for electric transmission in mines, and whilst holding the opinion that the conditions prevailing in the mine should be stringently inquired into before electricity at any pressure is taken into the workings, I believe that in 80 per cent. of our English mines high tension transmission would be perfectly safe.



2,000 kw., 750 r.p.m. 5,000 kw., 500 r.p.m., with condenser.

Elevations and Plans of 4-Stage Curtis Turbines, with 6,600-Volt Alternators.

(See opposite page.)

More care in the laying and jointing of cables would certainly be required, but if the proper cable be purchased, and regular systematic testing be insisted upon, there is no reason why the mine manager should be deprived of the economy of high tension distribution.

At the mines where I am employed, three-phase currents are transmitted down the pits at a pressure of 1,100 volts between phases, with a frequency of 50 cycles per second.

Transformers are placed as near the workings as circumstances will allow, and the electric haulage motors, pump motors, and coal-cutting machines are fed from the secondary side of these, at a pressure of 520 volts.

The electrical machinery in the mines is working night

and day, and it is surprising how little attention it requires to keep it in working order.

In conclusion, I should like to advise caution in installing electrical machinery for winding out of mines. There is little doubt that closer regulation could be secured by using electrical appliances for this purpose, and other advantages might also be obtained, but it is questionable whether an electrical winding engine could be designed to be more economical than the steam engines at present in general use, wasteful though they are.

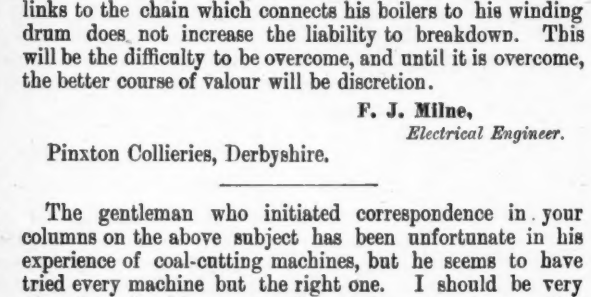
The facts that coal, and consequently steam, is cheap at collieries, and that usually the boilers are situated so close to the winding engines that the loss through condensation in the steam pipes is small, must be taken into consideration by the electrical engineer before advocating electric winding, and he must be able to prove that the addition of two more links to the chain which connects his boilers to his winding drum does not increase the liability to breakdown. This will be the difficulty to be overcome, and until it is overcome, the better course of valour will be discretion.

F. J. Milne,
Electrical Engineer.

Pinxton Collieries, Derbyshire.

The gentleman who initiated correspondence in your columns on the above subject has been unfortunate in his experience of coal-cutting machines, but he seems to have tried every machine but the right one. I should be very pleased to give him opportunities of inspecting in operation the Pickquick Bar Coal-cutters, which cut close to the floor, making their own pavement, and which have no tendency to rise into the face. The failure of the disc machine to which he refers, may have been due to the unsuitability of this type to the conditions to be dealt with in this particular seam, or it may have been due to a lack of persistent effort or resourcefulness of those in charge of it.

The shape and arrangement of the cutters of a coal-cutting machine have a vital bearing on the results obtained, and it is often impossible to predetermine what is the best form. This must be ascertained by intelligent trials under working conditions in the seam to be dealt with. Again, different seams require different treatment in respect of position, depth and direction of holing, and trials are often a necessary preliminary to the achievement of success.



Coal-Cutter Monthly Record Card.

The data on the back of the card are as follows:—Thickness of Seam, 2 ft. 8 in. Total Height at Face, 2 ft. 8 in. Nature of Holing, *Coal.* Nature of Roof, *Fakes.* Length of Face, 120 yds. Inclination of Face, 1 in 6. Size of Machine, *Medium.* Type, *Electric.* Duration of Cutting Shift in Hours, 7. Duration of Shift, Bank to Bank, 9½. Number of Men working Machine, 3. Number of Men clearing Cuttings, 1. Average Speed in Inches per Minute, 18. Average Depth of Undercut, 3 ft. 9 in. Average Square Yards per Hour, 50. Average Square Yards per Shift, 450. Average Watts per Square Yard Undercut, 11 kw. *for one minute.* Amperes, 19. Volts, 480. Average Tonnage per Shift, 110. Energy used, ·35 *unit per ton output.* Total Number of Shifts Worked, 22. Output for the Month, 2,413 *tons.*

It is for the mining engineer to select the type of coal-cutter best adapted to his requirements, and preferably one which has a fairly wide range of adaptability to different conditions of working. He is entitled to expect from the manufacturer machines that will in all their parts withstand the very strenuous service imposed upon them when holing in hard material, but when he is given such a machine it is for the mining engineer with such co-operation as the maker of the machine can give him to *make* it go.

Successful mechanical coal cutting depends upon so many factors external to the machine, and entirely beyond the control of its manufacturer, that he is powerless if the mine manager does not take on his own shoulders the responsibility of obtaining the best results. In short, the maker of the machine may properly be required to guarantee a cutting speed in inches per minute; assuming this to be satisfactory it lies with the mine manager to obtain the required yardage per shift, in other words, the tonnage output.

It is no exaggeration to say that wherever machine coal cutting has been successful, it has been due to active and intelligent interest and close, and persistent supervision by the management of the mine. A coal cutter is not a machine of a type which will go of itself. It must be made to go. Failures have, doubtless, been due to unsuitable and defective machines, but others have been due to the lack of driving power of an alert, intelligent and constant supervision.

There are now available several coal-cutting machines of proved capacity and durability, the product of years of experience, costly experience both to the manufacturers and to the coal owners, and I am sure the manufacturers of these machines will acknowledge how much they owe to the resourcefulness and enthusiasm with which many mining engineers have taken up the problem of mechanical coal cutting.

Your correspondent's discouraging experience is now, happily, an exceptional one, and the collieries in this country where machine mining by electrical coal cutters is in successful operation may be numbered by hundreds. As evidence of the reliability of coal-cutter motors, I quote the following from a report by the colliery engineer on the overhaul of a machine: "After 14 months' daily work holing in exceptionally hard material—Armature and field coils condition as new, gave coat of insulating varnish, and put back; commutator very slightly worn—not sufficient to require turning up."

As a matter of further interest, I enclose a coal-cutter monthly record card sent me by a colliery manager last week. The full line on the diagram shows the yards cut, and the dotted line the net cutting time. Other makers could doubtless show records equally satisfactory, but these may serve for the encouragement of your correspondent and others.

Sam. Mavor,
Managing Director, Mavor & Coulson, Ltd.

Glasgow, *February 22nd*, 1904.

Explosion of Enclosed Arc Lamps.

Re "Explosion of Enclosed Arc Lamps," I may tell you their danger was known as long ago as 1881. Indeed, the "Sun" lamp, the earliest of all enclosed arc lamps at the Exhibition of Paris, 1881, had to be provided with safety valves, maintained by springs and put on the covers of the globe.

L. Clerc,
(Chief Engineer of the Edison Co. of Paris, and Inventor of the "Sun" Lamp).

Paris, *February 20th*, 1904.

The Collection of Technical Matter for Reference.

Replying to "J. T. M." in last week's issue, I have myself tried many methods of collecting such data as your correspondent refers to, and I have found that the only really satisfactory method is the card index system, by which the subjects are indexed and cross-indexed alphabetically, while the press cuttings are inserted under numbered folders. By this means every press cutting gets a distinctive number, every card in the index referring to this particular cutting bearing the same number as the cutting itself. The cuttings are not pasted to the folder and may thus be withdrawn when required, without damage either to the cutting itself or to the folder in which it is contained. The advantages of the card index system in this respect over the scrap book or press cutting book are sufficiently obvious.

I may say that this system was suggested to me by the Library Bureau, Ltd., 10, Bloomsbury Street, London, W.C., from whom your correspondent can obtain all information.

R. J. Nicholson.

Manchester, *February 22nd*, 1904.

I have read "J. M. S.'s" letter on the collection of technical matter for reference, contained on page 291 of your issue of February 19th last, and would call your attention to the fact that the North of England Institute of Mining and Mechanical Engineers publishes annually a "Subject-Matter Index of Mining, Mechanical and Metallurgical Literature," a copy of which is sent to each of the members of the Institute. This publication was commenced in the year 1900, and contains over 200 pages of matter. All the papers indexed are carefully classified under the various subjects, so that anyone desirous of seeing what has been written on any particular question during the year may do so without trouble. All the principal English and foreign technical papers are received at the library of the above Institute, and there is no doubt that the compilation of such an index is of the greatest value to engineers generally.

M. Walton Brown.

Newcastle-upon-Tyne,
February 22nd, 1904.

An Unexplained Discharge.

Recently I had occasion to take out a pair of rubber insulated 37/14 cables. At one end the cables were connected to the supply company's fuse blocks, but the fuses had been drawn two or three days previously; at the other end the cables were hanging loosely away from the motor switchboard.

As the men were taking the cables down the lugs accidentally touched the ground, and we noticed a considerable discharge. I happened to recount this to some individuals in the trade afterwards, but they were ignorant of the cause, and refused to believe it, and now I find there are many such individuals. I should be very pleased if you will ventilate the matter in your columns, and perhaps an independent authority will explain in reference to the static discharge of an insulated cable, &c.

Microfarad.

P.S.—It will be observed that the lugs were disconnected from company's fuse blocks before attempting to take down the cables.

Gas v. Electricity.

I should be glad if any of your readers would inform me where I can obtain any reliable facts as to the quantity of gas consumed per C.P. per hour by various types of burners.

From facts that have recently come to my notice it would seem that, with electricity costing 5d. per unit, incandescent electric lighting cannot compete, and even the Nernst lamp has a hard struggle to keep pace with incandescent gas lighting, where the price of gas is about 4s. per 1,000 cb. ft.

Let it be understood that I am speaking of the average consumer, who considers the question as one of so much light for so much money.

To the class of consumer who understands and appreciates the advantages of pure air in his rooms, and looks far enough ahead to calculate how much he will save in painters' and decorators' bills, electric lighting will always appeal, even if its cost be slightly more than that of gas.

At the prices I have mentioned, and where a certain C.P. at the lowest initial cost is asked for, incandescent gas lighting is apparently more than a serious rival of electricity.

Agnostic.

February 20th, 1904.

[The consumption of gas per C.P.-hour is not the only point to be considered in the comparison. The amount of gas consumed in bye-passes must also be taken into account, for it attains a high value in the aggregate. Further, the divisibility of the light is an important point. Incandescent gas mantles are only made for nominal candle-powers (at starting) of about 50 and 25; hence, in a place where an 8-C.P. glow lamp would supply all the light required, it must either be replaced by a 25-C.P. gas mantle or by a common gas burner, which would consume as much gas as the former. The results attained on this basis were pointed out in a note on page 431 of the ELECTRICAL REVIEW of September 11th, 1903. These considerations are in addition to those relating to sanitation, decoration, &c.—EDS. E.R.]

Science and a Universal Language.

I was interested in reading a paragraph which appeared in the article entitled "Electricity in the Making of Music" (February 19th). In the paragraph to which I refer, mention is made of science and music going hand in hand together; the former, however, is said to be hindered in its progress by the many tongues of the various civilised races, and therefore in need of a universal language.

Might I, as one interested in the attempts now being made to overcome this deficiency in international progress, call attention to the London Esperanto Club, 41, Outer Temple, E.C., a club formed to propagate the international language Esperanto, and from which source particulars may be had at the cost of a postage stamp.

Progress.

[We are acquainted with the "Esperanto" movement, and are pleased to publish this letter calling attention to it. We believe that the system has a great future; certainly its progress has been very rapid, and it is intelligible without preparation to anyone having a smattering of the chief ancient and modern languages.—EDS. E.R.]

Electrical Contractors and their Rights.

I very much appreciate your leading article of the 19th inst., on Mr. Tweedy Smith's paper on the above subject, but I desire to repudiate the suggestions made by you where you imply that the contractor is fighting the supply station engineer. As a member of the London Electrical Contractors' Association, I have always heard the supply station engineer spoken of at our meetings with the greatest respect, but this remark does not apply to the different wiring rules which are issued by the various undertakers. The cause of complaint of our Association is more against the want of uniformity in the rules of undertakers than against responsible officials. The statements made at the meetings of our Association have strongly emphasised this point. The want of uniformity in the rules of the supply companies is not only detrimental to the contractor, but to the supply undertakers and to the industry generally, and if Mr. Tweedy Smith's paper and your article will be the means of bringing about greater uniformity in the supply rules, one of the objects of the Association will be achieved. It must be admitted that Mr. Tweedy Smith has brought forward many points which go to show that whilst undertakers have been anxious to see good work carried out in their various areas, they have been exceeding their powers in many respects in condemning good and legitimate work which did not exactly conform to their rules, whilst conforming to the rules of the Institution of Electrical Engineers and of undertakers in other areas. It is this point alone which the electrical contractor is particularly anxious to see cleared up.

It would be a good thing if your readers would give their views on this point of want of uniformity in rules, as much good might be derived, and the interests of the industry would be forwarded thereby.

W. R. Rawlings.

South Kensington, S.W.
February 23rd, 1904.

FALSE ADDRESS.—In our issue of the 5th inst. we published a letter on "A Question of Vibration," over the *nom-de-plume* "Puzzled." The letter was signed "Arthur G. P——, Chatham," and the address given was 114, Howe Street, Chatham. Two communications having been received in reply to "Puzzled's" letter, we duly forwarded

them to this address; they came back to us through the Post Office, marked "No such street at Chatham."

The giving of a false address, in pretended good faith, is a contemptible practice. We rigorously refrain from revealing the names or addresses of those of our correspondents who prefer to remain anonymous, to any person whatever; but we expect correspondents to keep faith with us.—Eds. E.R.

Electrical Rock Drills. — Will Mr. A. H. Gibson kindly communicate his address, his card having been mislaid?—Eds. E.R.

BUSINESS NOTES.

Ventilation of the House of Commons.—In spite of many attempts made to improve the ventilation of the Houses of Parliament, it is not yet all that could be desired, and it has now been decided to thoroughly overhaul the arrangements and to install new ventilating plant. Messrs. Matthews & Yates, Ltd., of Swinton, Manchester, and elsewhere, have received the order for this plant, and it is hoped by the commencement of another session to have it installed. During the past two years or so, Messrs. Matthews & Yates have supplied some 60 or 70 fans for the ventilation of committee rooms, division lobbies, lavatories, &c., and it is doubtless due to the satisfactory working of these fans, and the results obtained therefrom, that they have now been entrusted with the larger work of ventilating the Debating Chamber itself.

Belliss Engine Contracts.—The following contracts have been placed with Messrs. Belliss & Morcom:—

Kilmarnock.—By Dick, Kerr & Co., Ltd., four engines for direct coupling to English Electric Co., Ltd., dynamos.

The English Process Co., Ltd., Birkenhead.—By Siemens Bros. & Co., Ltd., two engines for direct coupling to Siemens dynamos.

Chesterfield.—By the British Westinghouse Co., one 580-h.p. engine for direct coupling to 400-kw. Westinghouse generator.

Tramway Point Shifters.—The electrical equipment department of Messrs. S. Dixon & Son, Ltd., of Leeds, has received an order for a further six point shifters for the Corporation tramways, and these are to be fitted at the most important junctions. Messrs. Dixon's electrical equipment department has lately been started for the manufacture of every class of overhead gear. The department is fitted with the latest machinery.

The Yacht "Erin."—We learn that the A.B.P. Accumulator Co., Ltd., of Stockton-on-Tees, have just completed a second order for cells for Sir Thomas Lipton's yacht *Erin*.

The Paterson Water Softener.—The Paterson Engineering Co., Ltd., of Amberley House, W.C., has received the order from the British Westinghouse Co. for a Paterson combined feed-water softener and grease eliminator for the Northampton tramway power station.

Manchester Association of Electrical Contractors.—The first annual dinner of the Manchester branch of the National Electrical Contractors' Association was held last week at the Mosley Hotel. The gathering was presided over by Mr. J. M'Dermott, president of the Manchester section. Mr. W. R. Rawlings, president of the National Association, in responding to the toast of "The Association," referred to the progress which had been made, and the possibilities of future development. Already about 500 contractors were connected with the Association, 200 of these being in London, and the remainder in different parts of the country.

Stolen Cable.—At the County of London Sessions last week, Robert Tiffen, fitter, was sentenced to one month (second division), and Herbert Ellis, clerk, to 18 months' hard labour, for stealing high-tension trunk mains, the property of Messrs. Siemens Bros. & Co., intended for the New Cross electric trams. Alfred Toms, marine store dealer, of Old Street, who was already undergoing another sentence for receiving other stolen cable, was ordered to be kept in penal servitude for three years for receiving cable stolen by Tiffen and Ellis.

New Arc Lamp.—Messrs. Strubin & Jaye, of 61, Cornhill, E.C., have sent us particulars of the "Economic" patent electric closed arc lamp which they are introducing. This lamp is intended to burn on any pressure between 80 and 150 volts, and at any current from 1·5 to 3 amperes; the candle-power is stated to be 350 with 3 amperes at 115 volts. It is 12 in. in height, and burns for 18 to 20 hours with one trimming, after which the top carbon can be used as a bottom carbon. Further particulars can be obtained on application to the makers.

Imports of Foreign Electrical Machinery and Apparatus.—The value of the foreign electrical machinery imported into this country during January last is returned at £46,937, as compared with £49,375 in the preceding month and £62,137 in the first month of 1903. Of foreign electrical goods and apparatus, the imports last month reached a total of £74,674, which compares with only £52,777 in January a year ago.

Municipal Contract Clauses at Manchester.—It is announced that the British Westinghouse Co., of Trafford Park, have agreed to the insertion of the "fair wages" clause in all their municipal contracts, to join the Employers' Federation, and to abide by the working terms mutually agreed upon by the Federation and the representatives of the trades unions. In an interview with a Press representative, Mr. Loud, the general manager of the company, said that, up to now, the Westinghouse had been an independent or "outside" concern. "We find, however," he went on, "that we have unwittingly transgressed some of the rules of the trade unions, and, in order to strangle criticism and avoid friction, we have decided to join this Federation and accept the conditions and rules which have been agreed to by the organised employers and the organised workers." A Manchester paper says:—"The concession which the company has made is the final outcome of prolonged negotiations between the company and the trade unions. When the works in Trafford Park were opened, the intention of the company was to manage them precisely as their works were then managed in Pittsburg, but there arose very quickly a dispute on the question of overtime. In Pittsburg and all through the United States it was the custom to pay time and a half for all overtime, and this was what the Westinghouse Co. began to do at Trafford Park. But the trade unions in England have another rule. They require time and a quarter for the first two hours of overtime, time and a half for the second two hours, and double time for the third two hours. The trade unions pressed the Westinghouse Co. to adopt the English rule. The company tried to show the trade unions that the American method was the more advantageous for all concerned, but in the end the company yielded the point."

Aluminium.—The *Times* says that in consequence of the great increase in the demand for aluminium the British Aluminium Co., Ltd., have again found it necessary to increase the capacity of output of their Foyers works by the erection of two additional series of aluminium furnaces.

Book Notices.—*Motoring Annual, and Motorist's Year Book*, 1904. London: *Motoring Illustrated*, 9, Arundel Street. This is a publication which should be interesting to all who are concerned with automobilism either industrially or as a hobby. The first 100 pages form a personal section of more or less eminent motorists. Particulars relating to the various clubs, some data respecting famous hill-climbing and other tests, a vocabulary of technical terms, types of motors, types of tires, and a directory of manufacturers are the main contents.

Directory of Electric Lighting and Electric Traction, 1904, by C. S. Vesey Brown. London: Hazell, Watson & Viney, Ltd. 10s. 6d. The work involved in the production of this directory—as indeed is the case with all similar publications respecting electrical supply and manufacturing—becomes greater every year. The new lighting and traction systems opened since the last edition have involved additions all through, so that the compiler has done well to eliminate certain extraneous information which can be found in gas directories. One can find out easily by a reference to "Vesey Brown's book" the general information respecting the plant employed, the financial returns, and the *personnel* of any lighting, power, tramway or railway system in the United Kingdom. We note that the price has been increased from 6s. net to 10s. 6d. net.

"Manual of Electrical Undertakings and Directory of Officials. 1904," by Emile Garcke. Vol. viii. London: Mowbray House, W.C. Price 15s. net.

"Les Cables Sous-Marine," by A. Gay. Paris: Gauthier-Villars. 2 fr. 50 c.

"The Technology Review." January, 1904. Boston, Mass.: Association of Class Secretaries. 35 c.

"The Indicator Handbook." Part I: Its construction and application, by C. N. Pickworth. Second edition. Manchester: Emmott and Co., Ltd. 3s. net.

"Simple Experiments in Static Electricity," by P. G. Bull. London: Percival Marshall & Co. 6d. net.

"Transactions of the Institution of Civil Engineers of Ireland." 68th session, to May, 1902. Dublin: The Institution.

Bankruptcy Proceedings.—A receiving order has been made against S. H. and J. E. Thompson (Thompson Bros. & Co., electricians, Plymouth) on their own petition.

Dissolutions and Liquidations.—A petition to wind up the McGuire Manufacturing Co., Ltd., has been presented by the Electric Equipment and Securities, Ltd., of Dashwood House, E.C., and it is to be heard on March 1st.

A meeting of the Electric Resistance and Heating Co. is to be held at Dashwood House, E.C., on March 25th, to hear an account of the winding-up from the liquidator, Mr. W. Chaplin.

A meeting of creditors of Ferranti, Ltd., is to be held at Winchester House, E.C., on Wednesday, March 2nd, at 2.30 p.m., when the committee of creditors will present its report.

Mr. Justice Byrne, in the Companies' Winding-up Court on Tuesday, on the petition of Mr. G. Skipworth, a judgment creditor, made a compulsory order winding up the National Electric Traction Co., Ltd.

Ferro-bleach.—We have received from Mr. Wm. Tylar, of 41, High Street, Aston, Birmingham, a sample bottle of his Ferro-bleach, which is recommended as an excellent substitute for "soda ink," when making alterations on blueprints. The Ferro-bleach does not run, and will not rot the paper.

For Sale.—Offers are invited for the electrical engineering business of Messrs. McAulay, Clark & McLaren, of Glasgow. See our advertisement pages to-day.

The goodwill of the business carried on by the Stewart Electrical Syndicate is offered for sale. See our advertisement pages to-day.

Trade Announcements.—The firms of N. C. Woodfin, A.I.E.E., 13, Queen Square, Bristol, and J. W. Helps & Co., Old King Street, Broadmead, Bristol, have been amalgamated under the style of Helps, Woodfin & Co. The new firm will carry on business as electrical manufacturers and contractors, at the Excelsior Electrical Works, Old King Street, Broadmead, Bristol. Mr. Woodfin's name will be recognised by our readers as that of a contributor of several practical articles to the Electrical Review, and they can wish him nothing better at the moment than that the present amalgamation will produce that extension of business which is its object.

A Smart Piece of Work.—As some of our readers are aware, a serious fire occurred recently at the Birley Colliery, near Sheffield, in consequence of which a 30-kw. generator and part of the electric lighting circuit were destroyed. At noon on Wednesday, January 27th, Messrs. Taeker, Sons & Co., Ltd., Angel Street, Sheffield, received the order to obtain and install a new generator and the necessary cable. Considerable difficulty was experienced in finding in stock the generator and cable required, but finally the dynamo was found at Rugby, and the cable 20 miles south of London, and the whole was received at the colliery early on Friday morning. By 6 o'clock a.m. on Saturday the plant was running; and when it is mentioned that 500 yds. of 19/12 concentric cable—including the fixing of 300 yds. of this cable in the shaft—was installed, the whole performance may justly be claimed as smart work as regards time.

New Arc Lamp Mechanism.—An exceedingly simple and ingenious device, suitable for d.c., a.c., open or jenclosed, or flame arc lamps, was shown to us recently by the inventor. We are at present unable to disclose the details, but we believe that the irreducible minimum has been attained in the number and cost of the working parts. Both carbons are above the arc, and magazines for automatic renewals can easily be fitted.

LIGHTING AND POWER NOTES.

Acton.—The U.D.C. has sealed an agreement with the Metropolitan Electric Supply Co. for the supply of energy in bulk. Mr. W. H. Trentham, the Council's engineer, recommended that a clause should be inserted in the agreement to the effect that the carrying out of the agreement would be subject to the sanction for a loan being obtained from the L.G.B.

Anglesey.—The C.C. on February 18th, unanimously decided to oppose the Bill promoted by the North Wales Power and Traction Co., on the ground that the Bill gives the company undue preference over local authorities.

Barnstaple.—The E.L. Committee on the 15th inst., presented a statement showing the cost of the first year's working, ending January 28th, of the E.L. undertaking. The expenditure amounted to £1,488, and the receipts were £2,164, leaving a gross profit of £676. From this have to be deducted charges for interest and redemption, depreciation, &c., which will probably leave a deficiency.

It was recommended that the Committee consider the advisability of reducing the cost per unit to 5d. The amount received for energy sold for all purposes was £2,142.

Barton Regis.—The R.D.C. on February 19th considered the proposals of the Southern District Electricity Corporation for E.L. powers. It was stated that the Great Western Railway Co. might possibly introduce electricity into the district, but the clerk said they could not supply, as the Council possessed its own Order. The Southern Corporation had offered to take all liability and risk. The Council decided to withhold its consent.

Blackpool.—Mr. C. Furness, the borough electrical engineer, proposes, in a report to the Electricity Committee, that a reduction be made in the price of energy for private lighting, from 7d. and 2d. per unit, maximum demand, to 7d. and 1d.

Brighton.—The Corporation has resolved to apply to the L.G.B. for sanction to borrow £4,000 for the purpose of completing the changing over of the supply to higher voltage. The resident engineer reported that only about one half of the area had been changed over at present, and owing to the re-arrangement of the feeders which would be necessary in connection with the new switchboards for working in conjunction with the Southwick power scheme, it was essential that the remainder of the area should be changed over this spring.

Cardiff.—The electrical engineer (Mr. Ellis) recently presented his estimate of expenditure and receipts for the year ending March 31st, 1905. The expenditure was put down at £22,382, compared with £16,386 estimated for the current year, and £11,271 actual expenditure in 1903. The receipts for next year were estimated to reach £37,750, leaving a profit balance of £5,181. The Lighting Committee resolved that £3,000 be allocated to the relief of rates, and that £2,181 be placed to reserve. For the current year the amount allocated to relief of rates is £2,900. Mr. Ellis also presented a report showing that £38,000 would be required for extensions of cables and feeders, including work at the municipal buildings and law courts, and it was resolved that the L.G.B. be asked for borrowing powers to that amount.

Ceylon.—Mr. A. S. Barnard, electrical engineer to the Government, has reported upon the lighting of Galle, and it is stated that the cost (about 75,000 rupees) of the scheme is too heavy to permit of the Council undertaking the supply of electrical energy.

Chester.—At a meeting of the T.C. on 17th inst., it was asked to confirm a resolution passed at the previous meeting increasing the salary of the electrical engineer (Mr. Thursfield) to £550, rising by annual increments of £50 to £700. Letters of protest were received from the Chester Traders' Association and Chester Ratepayers' Association. The Council declined by 19 votes to 16 to confirm the increase of salary.

Crediton.—The U.D.C. has assented to Messrs. Christy Bros. and Middleton, of Chelmsford, who are applying for a prov. order to light the district, charging a maximum of 8d. per unit for the first hour and 4d. afterwards.

Dumfries.—The T.C. on 22nd inst. considered tenders from four companies who were willing to take the transfer of the burgh's prov. order for electric lighting, and resolved to submit the offers of Messrs. Crompton & Co., and the India-Rubber and Gutta-Percha Co., to Messrs. Buchan & Hogarth, Edinburgh, with a view to their advising the Council in its selection.

Durham County.—The C.C. is making inquiries as to the views of the various local authorities on the suggestion to adopt a county scheme of electrical supply. At a meeting of the Weardale D.C. it was pointed out that the district had a good water supply that might be utilised for generating purposes.

Ealing.—The T.C., on the recommendation of its electrical engineer, has resolved to install a new 750-kw. set, to cope with next winter's load, at an estimated cost, with all accessories, of about £10,000. The contribution by the electricity department to the district rates and taxes, resulting from the recent assessment, has been increased to £530.

East Ham.—The U.D.C. has received from the L.G.B., sanction to borrow £14,430 for additional plant for the electric lighting works.

Edmonton.—The U.D.C. on 23rd inst., agreed to pay Mr. R. Hammond, whose scheme for an electrical undertaking has been adopted, 5 per cent. on the estimated cost, which he has put at £44,000. He will not receive remuneration on any expenditure beyond that amount, should it be necessary.

Enniscorthy Asylum.—Tenders have been submitted for a scheme which is to make use of an existing water-mill to drive a generator for supplying electrical energy for lighting and power purposes. The energy will be transmitted a distance of 1½ miles to the Asylum, at a pressure of 600 volts, to a motor-generator, which can be driven by two 25-h.p. engines should the mill or overhead conductors fail from any unforeseen cause. A battery of accumulators will be installed as a stand-by, which will act as an all-night supply. The laundry and other machinery, taking about 20 h.p., will be operated by electric power instead of steam. The specifications were by Mr. H. T. Harris, of Dublin.

Exeter.—The installation for the electric lighting of the Cathedral was completed last week. It is the gift of Mr. Henry A. Willey, of Messrs. Willey & Co., Ltd., engineers, Exeter, and comprises 14 pendants in the nave, 13 in the choir, and six in the Lady Chapel, each with seven lamps.

Falmouth.—An agreement was recently entered into with Messrs. Crompton & Co. by the T.C. for the electric lighting of the town, but the B. of T. objected to the contract, and insisted on a transfer. A form of transfer has been drawn up, but is not considered by the Board to be satisfactory.

Frome.—The L.G.B. has sanctioned the borrowing of a further sum of £8,500 for electrical purposes.

Germany.—An electric lighting works is to be established in the town of Nordbastedt (Holstein).

Gorton.—The Electricity Committee of the T.C. has resolved to lease its prov. order for electric lighting to the Manchester Corporation.

Halesowen.—The U.D.C. has entered into an agreement with the Empire Electric Lighting Co. for the disposal to the company of its electric lighting order. The terms of the agreement are that the company undertakes within six months to construct an electric generating station within the district. It also undertakes to light the public lamps in the district at the same price charged by the gas companies, and to provide all the necessary columns, &c.; further, to supply electricity for the lighting of the municipal buildings at the rate of 5d. per unit, and to private consumers at 7d. per unit. At the end of 21 years the Council may purchase the undertaking as a going concern.

Ham.—The Edmundson's Electricity Corporation has declined to reduce the price for energy to private consumers, to 6d. and 3d. per unit, with a flat rate of 5d., terms demanded by the U.D.C. in order to obtain its assent to the company's application for a prov. order. The Corporation will therefore dispense with the Council's assent.

Hanley.—The accounts for the past year recently submitted to the Corporation show a gross profit of £7,507, out of which £2,555 has been paid for interest, and £2,510 for sinking

fund and redemption charges, leaving a net profit of £2,443 for the year. It was resolved that £2,351 should be repaid to the district fund account, being the amount now standing there to the debit of the electric lighting revenue account, and that the sum of £195, including £109, balance from previous year, should be carried forward to the current year's account. The chairman explained that the sinking fund now stood at £15,858.

Hebden Bridge.—The U.D.C. electricity works were opened on February 17th. About 7 miles of cables have been laid, and the storage battery of 260 cells is capable of supplying 400 16-c.p. lamps for 10 hours. The scheme has cost from £7,000 to £8,000.

Heckmondwike.—The U.D.C. has decided to adapt the public lamps in 19 streets to the electric light.

Subject to the Co-operative Society taking the whole of its supply of energy from the Council, the price of energy will be reduced to 4d. per B.T. unit.

High Wycombe.—The T.C. has considered the question of purchasing the undertaking of the E.L. company, but has decided that it is not desirable to do so at the present time.

Hornsey.—The B.C. has decided to hold an electrical exhibition in the Christchurch Schoolrooms from Tuesday, March 1st, to Saturday, the 5th, inclusive.

Huddersfield.—The Electricity Committee reports that the income for the year ended December 31st last amounted to £26,005, as against £23,159 in the previous year. The expenditure had been £12,627, as against £10,404. The gross surplus was £13,378, and the net balance, after paying capital and redemption charges, was £3,915, as against £2,945. It was recommended that the surplus should be transferred to the depreciation and contingencies account, which now amounts to £11,853.

Lancaster.—Messrs. F. H. Royce & Co., of Manchester, have installed the electrical plant for the new motor factory of Messrs. W. Atkinson & Sons. The fittings have been supplied by the Lancaster Electrical Supply Co.

Launceston (Tasmania).—The new plant which is being installed by the City Council was described by the mayor at the final meeting of the municipal year; it was stated that the four existing turbo-alternators are to be replaced by four three-phase generator sets, each of 400 H.P., which is three times the total power of the present machines. The whole of the new plant is being supplied by Kolben & Co., of Prague. For the supply of power for motors during the daytime, at least 1,000 H.P. out of the 1,200 H.P. will be available. The Council, on the advice of the city electrical engineer, has decided to greatly reduce the price for energy for power purposes, and the rental for motors supplied on hire. The reductions took effect from January 1st, since when all current in excess of 200 units (at 2d. per unit) has been ½d. per unit. Rental charges on motors were reduced at the same time from 30 to 15 per cent. per annum. The Council intend to give users the full benefit of the low price which will be paid for the new motors. As an example, a 3-H.P. motor will be priced at £21, and the quarterly rental will be 15s. 9d.

Leeds.—The Lighting Committee of the Corporation has resolved to accede to the application of the Street Lighting Committee for the supply of energy at 1½d. per unit for street lighting only. It was stated that the average cost of generation amounted to 3d. per unit.

Lichfield.—A number of the ratepayers have resolved to support the application of the Corporation to the B. of T., for a prov. order for electric lighting, amending the order granted in 1901, and also extending the area of supply to the parishes of Whittington, Shenstone, Swinfen, Packington, Welford, Wall, Longdon, Fisherwick, King's Bromley, Farewell and others.

The military authorities at Whittington Barracks have made application for a more sanitary disposal of the refuse, and in view of this it is suggested that a refuse destructor and electric lighting works should be combined. A memorial against the application has been sent to the B. of T. by another body of ratepayers.

London.—Battersea.—The Lighting Committee of the B.C. has decided to support a petition from the Incorporated Municipal Electrical Association asking the L.G.B. to take steps to authorise Borough Councils to contribute as members of the Association.

Bermondsey.—The district auditor has taken exception to expenditure amounting to £1,780 incurred by the B.C. for wiring consumers' premises. The charge was, however, covered by a sanction under the Local Authorities (Expenses) Act, obtained from the L.G.B. during the audit. The matter has been referred to the Electric Light Committee for consideration and report.

Southwark.—On 19th inst. the L.G.B. inquiry into the application of the B.C. for a scheme providing that the expenses of the Newington electric lighting undertaking should be chargeable to the whole borough, was concluded. Strenuous opposition was offered by the parishes of St. George-the-Martyr and Southwark, the St. Saviour's district, and a number of ratepayers. Supply was first given on September 8th, 1899, and since then the net deficiency on the undertaking was, according to the applicants, £3,941.

Lambeth.—At a concert attended by about 1,300 persons recently, the company's electrical supply for lighting the building failed, and after the lapse of 12 minutes the rival company's supply was connected up.

Marylebone.—A daily paper states that the B.C. has been asked to pay £2,600 for the attendance on the 33 days during which the arbitration proceedings lasted, to one of its electrical experts, in accordance with an agreement previously made with him. Some slight modification of the terms was conceded.

A committee of ratepayers, which was formed a few months ago, has laid before the L.G.B. certain facts connected with the purchase of the Metropolitan Co.'s undertaking by the B.C., stating that if the Board should deem it proper, a measure should be introduced in Parliament to remedy certain apparent defects in municipal government. The Committee suggests that no contracts should be made or Bills promoted by municipalities involving a charge upon future years, unless a majority of two-thirds of the electors have signified their approval.

Poplar.—The Lighting Committee of the B.C. report that Mr. P. W. Hooper, the recently appointed borough electrical engineer, had stated that on the whole the plant and mains are in a satisfactory state. The plant was run at some risk during the last winter. Certain appplications for energy were refused, and others were granted only upon condition that the supply was not taken for six weeks on either side of the shortest day in the year. It is, therefore, necessary that consideration be at once given to the question, how to provide for next winter's demand. The engineer suggests that the two small sets should be replaced by two generators, each of 1,000 KW. capacity. The present plant would then be increased by 1,800 KW., and either of the two generators be available during next winter, the present boiler power being sufficient to drive one of the new engines, the other affording a very necessary reserve. The high tension alternating three-phase system is intended to be adopted in connection with the new machinery, and the scheme, as a whole, will involve a capital expenditure of £65,500, made up as follows:—generating station £20,000, mains and south district £25,500, north district £14,000, deck crossing subways £6,000. For the present, however, it is only necessary to provide for the supply of the two generators, with foundations, condensing plant and switch gear at an estimated cost of £16,000, and it is essential that the two generators should be obtained as soon as possible. The Committee further report that their attention has been directed to the case of Colwell and others *v.* St. Pancras B.C. It is suggested that authorities owning electric lighting undertakings should combine and approach the B. of T. with a view to the abolition of the nuisance clause in the prov. orders authorising the undertakings, and that a clause should be substituted giving powers to undertakers to acquire property compulsorily. The Committee are in favour of such steps, and recommend that a petition upon the lines indicated be sent to the B. of T.

Hammersmith.—The B.C. has refused a request by the Guardians that the electrical engineer be permitted to supervise the electrical installation at the new workhouse and infirmary buildings.

Hackney.—The Finance Committee of the B.C. has submitted an estimate of £3,996 for distributing mains, and a recommendation that application be made to the L.C.C. for sanction to borrow that amount.

Lynn.—On 16th inst. the L.G.B. held an inquiry into the application of the Corporation to borrow a further £11,500 for E.L. purposes.

Maidstone.—A sub-committee which was appointed to consider the lighting of additional streets recommended that a further 14 arc lamps and 13 Nernst lamps should be installed, at a total cost per annum of £224. This was adopted.

Newcastle-on-Tyne.—The Corporation Watch Committee has recommended the T.C. to have the whole of the Council schools in the city lit by electricity, from its tramways generating station.

Prestwich.—The U.D.C. has notified its intention to transfer its electric lighting order to the Salford Corporation.

Shildon.—The U.D.C. has entered into an agreement with the Northern Counties Electric Supply Co. for the erection of an electricity works and a refuse destructor.

Spain.—Authority has been given to the Marques de Santillano to construct a water-power plant on the River Manzanares, for supplying energy to the upper zone of Madrid, and for the laying down of a plant on the River Guadarrama for industrial purposes exclusively.

Don Juan Bonz Alvares has been granted authority to appropriate water from the Tajo River, in Almonacid de Zorita, for electric power purposes.

Sydney (N.S.W.).—The district authority at Newtown has applied to the City Council for a supply of energy for lighting purposes.

Torquay.—The T.C. has adopted the recommendation of its Electricity Committee to transfer the site for its electricity works to Upton Valley, and it is estimated that a saving of at least £3,000 will be effected, but new plans will be necessary. This was the site originally decided upon.

Tottenham.—The U.D.C. has resolved not to proceed further with the electric lighting scheme submitted recently.

Watford.—The U.D.C. last week adopted the recommendation of its E.L. Committee to drop negotiations with the North Metropolitan Electric Supply Co., who were asked to make an offer for the undertaking. The Council further decided to apply to the L.G.B. for sanction to borrow £26,000 for enlarging the plant, £10,000 to be laid out this year. It is stated that Major Cardew will be asked to advise the Council, as to its new scheme, at the forthcoming L.G.B. inquiry.

Walthamstow.—Several consumers having complained that unsuitable lamps had been sold to them, the U.D.C. has intimated that incandescent lamps of good quality and suitable for the pressure of supply available in the district, may be obtained at the Municipal Electricity Works at the following prices:—8 and 16-c.p. lamps 1s. each; 32 c.p. lamps 1s. 3d. The National Boiler and General Insurance Co., Ltd., has offered to insure for £10,195, the gas engines, dynamos, switchboards, boosters, balancers, motors, gas plant, and motors on consumers' premises against breakdown, &c. The annual premium would be £268. It was resolved to obtain quotations from three other insurance companies. The electrical engineer reported that the incandescent electric lighting posts are fitted with two 16-c.p. glow lamps which consume ·128 of a unit per hour. The average number of lighting hours in one year is 3,631. The consumption of the two lamps is therefore 464 units per annum, which at 3d. per unit is equivalent to £5 16s. per annum. The charge of 3d. per unit includes the cost of energy, repairs and maintenance of the street lighting mains, also the interest and sinking fund charges on the cables, lamp brackets, and other apparatus installed in the posts. It was resolved to ask the electrical engineer and the lighting foreman to report on the cost of incandescent, electric and gas lamps. It was decided to lay cables on the Forest Estate, and to apply to the L.G.B. to sanction a loan for £6,054, the estimated cost of the work. The L.G.B. has sanctioned a loan of £1,091 for lamp columns for electric lighting.

Willesden.—At a recent U.D.C. meeting the solicitor reported that the sale of the electricity works had been completed, and the sum of £8,633 8s. 2d. had been paid in connection therewith. The balance secured to the Council by mortgages was in respect to the site, £2,458 7s. 8d., repayable in 55 half-yearly instalments; and in respect to the buildings, machinery, &c., £61,556 16s. 3d., repayable by 48 half-yearly instalments.

TRAMWAY AND RAILWAY NOTES.

Adelaide (S. Australia).—The option granted to Mr. F. H. Snow in connection with a system of electrical tramways for Adelaide and suburbs expired on December 31st. Should this scheme not be carried out, it is probable that the existing horse car companies, or some of them, will amalgamate, with the view of introducing electricity.

Burnley.—A new 400 h.p. set commenced running last week; this additional machinery was rendered necessary through the opening of another branch of the tramway system.

Cape Town.—The receipts of the Cape Electrical Tramways (Port Elizabeth) for January amount to £4,553, and expenses to £3,032.

Dunedin (N.Z.).—The official opening of the first section of the municipal electric tramways took place on December 18th. It is expected that the entire system will be in operation within six months; the contract has been carried out by Noyes Bros., of Melbourne and Sydney, as agents for the Westinghouse Co.

Germany.—The Saxon Wagon Works Co., of Werdau, have just completed an electrical railway carriage for use on the branch line of the Saxon State Railway between Dresden and Cossebande. It will replace a train, has accommodation for 98 passengers, and is propelled by means of energy furnished from a battery of accumulators carried on the vehicle itself.

Halifax.—On the 18th inst. the Tramways and Electricity Committee inspected the Central Tramways depôt at Skircout New Road, which has been extended at a cost of £12,000. Subsequently a new Corliss engine of 1,200—1,500 I.H.P., constructed by Pollit & Wigzell, and coupled to an E.C.C. generator available for either lighting or traction work, was started by Alderman Hey, who later entertained the company to light refreshments at the Town Hall.

Hove.—The Arbitrator appointed to assess the value of the portions of the Brighton and Shoreham tramways in Hove and Portslade, which the local authorities have the right to purchase from the B.E.T. Co., has fixed the price at £3,538 for Hove, and £4,762 for Portslade, with costs to the B.E.T. Co., exclusive of the sums spent in converting the lines to electric traction. Hove T.C. offered only £1,122, and Portslade U.D.C. £462.

Japan.—A financial daily says that a scheme to construct an electric railway between Kyoto and Otsu has been approved, and a syndicate has been formed in the United States to carry the enterprise through. The length of the road is about 30 miles.

London.—L.C.C.—The question as to the actual receipts of the new electric tramways in the south-west of London was raised at the meeting on Tuesday by Sir Henry Bliss. In reply, Mr. J. W. Benn stated that the average revenue had amounted to 12·21d. per car-mile, and that the Council had therefore exceeded the estimated receipts, although exceptional difficulties had been experienced during the year. That figure compared with 10·61d. per car-mile with horse traction on the London Tramway Co.'s system, and 10·30d. on the South London system.

The Highways Committee reminded the Council of the acceptance in May, 1902, of the tender of Messrs. Siemens Bros. & Co. at £31,743 for the supply and laying of the high-pressure cables required in connection with the reconstruction of the tramways. A considerable quantity of the cable had already been laid, but the remainder could only be brought into use when the Greenwich power station has been opened. In these circumstances the contractors had asked for some payment to be made on account of the cables already laid, and, as the request appeared to be reasonable, the Council decided to comply with it.

It was decided to adopt the conduit system for the tramways in Goswell Road on reconstruction as double lines. The estimated cost of the roadwork in connection with the doubling amounts to £6,600.

It was stated in the House of Commons the other night, on behalf of the L.C.C., that the total value of all contracts let by the L.C.C. for tramway works is about £2,000,000, of which amount £150,000, or 7½ per cent., represents foreign work. The Council began by restricting the tenders for this work to British firms; but, owing to the limited number of tenders and the high prices, it adopted open competition, and, as the result, all materials are now being obtained in this country, and at much lower prices. Altogether, the Council estimates that it has saved in rails alone about £40,000 by its policy of open competition. No contracts have been sent to Germany.

Perth.—On 17th inst. a meeting of the special Tramway Reconstruction Committee of the T.C. was held for the purpose of hearing the report by Messrs. Kincaid, Waller, Manville & Dawson, London, the consulting engineers, who estimated the cost of reconstruction at £46,000. There has to be added to this £21,800, the price already paid for the tramways, and the total, including engineers' fees and Parliamentary expenses, will amount to about £70,000. The engineers recommended that the line should be extended on the north side of the city to Dankeld Road, which will involve a cost of £4,500. Among the other recommendations is the laying of heavier rails, and the acquisition of 12 double-deck cars. The reconstruction scheme (including the extensions at the power station) and the purchase of the tramways will, in the end, involve an expenditure altogether of nearly £100,000. The report is to be considered at a special meeting of the Council.

Rowley.—At the meeting of the U.D.C. on Monday, the Tramways Committee reported that a sub-committee had met the representatives of the Birmingham and Midland Tramways Co., and recommended that the tenders of the company for the construction of the tramways and also for the providing of the parts of the electrical equipment be accepted. They further recommended that a loan of £27,680 be raised to cover the cost.

Stockport.—The result of the year's working of the electric tramways is said to have been better than was anticipated. The borough treasurer estimates that the deficit of £563 will be cleared off, that all capital charges will be met out of revenue, and that a small surplus will remain. The general expectation was that there would be a loss, requiring a rate in aid. There was a loss of £800 on the first year's working.

Sunderland.—The estimate for the year ending March 31st next, was submitted to the meeting of the Tramways Committee on the 18th inst., and approved. It shows an estimated income of £63,061; for the previous year the income was £59,930. The estimated expenditure is £35,240 13s. 5d. This gives a gross profit of £27,820, which it is proposed to dispose of in the main as follows:—Compensation reserve fund, £500; interest, £8,670; depreciation, renewal, and sinking funds, £13,690; leaving a net profit of £4,766, as against £5,000 for the previous year.

Wolverhampton.—In regard to the recurrence of a live stud, mentioned in our last issue, a Wolverhampton correspondent writes:—For the first time since the Lorain surface contact system of electric traction has been put down, it had on Wednesday in last week to cope with a severe snowstorm, and it must be frankly admitted that it successfully survived the ordeal. Something of the nature of a mild sensation, however, occurred during the morning. A flock of sheep was being driven through Chapel Ash, when one of the animals trod upon one of the contact boxes, and it immediately fell to the ground dead. An inquisitive dog went to see what was the matter with the sheep, and it is supposed that it also put its feet upon the same box, and it met with the same fate. A few minutes later a baker's cart travelled over the same spot, and when the horse reached the "box" it was brought to its knees and began to quiver as if shocked. A number of persons who had witnessed the occurrence went to the assistance of the animal, which was soon got on its feet, and was led away more frightened than hurt. The sheep and dog, however, were dead. It is supposed that the box on which the sheep and dog stepped was in a "live" condition at the time. It should be added that no accident has happened which could be attributed to the existence of a "live" box since the death of a horse belonging to Mr. Gibbons, a car proprietor, many months ago, for which compensation was paid. One witness of the occurrence last week stated that a piece of wire had fallen across the contact box, and that when the car passed over it there was a loud report, and also that the conductor of the car picked up the wire and took it away. Immediately afterwards the animals passed over the spot with the result indicated above.

TELEGRAPH AND TELEPHONE NOTES.

The Telegraph Department.—An "account showing the gross amount received and expended on account of the telegraph service during the year ended March 31st, 1903, and the

balance of expenditure over receipts" has been issued as a Parliamentary paper. The gross amount received by the Post Office in respect of telegrams, private wire rentals, special wire rentals, and so forth was £4,190,813 16s. 6½d. If there are then deducted (says the *Times*) the amount paid to the cable companies and moneys refunded to the public, a balance of £3,631,745 6s. 4½d. remains. The value of telegraph services performed for the other public departments without remuneration is put down at £92,121. The balance of expenditure over receipts equals £601,711 8s. 2¾d.

Telegraphic Interruptions and Repairs :—

Cables.	Interrupted.	Repaired.
Dominica-Martinique	May 5, 1902	
St. Lucia-Martinique	May 7, 1902	
Trinidad-Demerara No. 1	Aug. 27, 1901	
Mole St. Nicolas-Port-au-Prince	Dec. 16, 1903	
Cayenne-Pinheiro	Aug. 18, 1902	
New York-Hayti	April 18, 1903	
Anjer-Kalianda	Aug. 2, 1902	
Beissa-Issa (Yemen)-Camaran	Oct. 22, 1902	
Tourane-Amoy	Nov. 10, 1903	
Tarifa-Tangier	Jan. 18, 1904	
Oran-Tangier	Feb. 3, 1904	
Nagasaki-Vladivostock	Feb. 15, 1904	
Port Arthur-Chefu		
Landlines.		
Seoul-Masampo	Feb. 13, 1904	
Seoul-Gensau	Feb. 13, 1904	

CONTRACTS OPEN AND CLOSED.

OPEN.

Aston Manor.—March 14th. Water-tube boilers, superheater, and stoker. See "Official Notices" to-day.

Austria.—March 20th. The Municipal Authorities of Retz are inviting tenders until March 20th for the establishment of a central electric lighting station in the town.

Belfast.—March 11th. Motors, cables, conduits, piping, bitumen, &c., for the Electric Department. See "Official Notices" to-day.

Bermondsey.—March 1st. Wiring of buildings, &c., at the generating station. See "Official Notices" February 19th.

Blackburn.—February 29th. Stores for the Electricity and Tramways Department. See "Official Notices" February 12th.

Canary Islands.—March 23rd. Electric tramway between San Cristobal de la Laguna and Tacoronte (Canaries). See this column for February 19th.

Chili.—June 28th. Electric lighting of the city of Punta Arenas (Straits of Magellan). See this column for February 19th.

Cambuslang.—February 29th. Tenders are invited for engines, dynamos, switchboard, and lamps, main and distributing cables, and other works necessary to provide a complete system of electrical supply within the special lighting district. See "Official Notices" February 12th.

Cape Town.—Arc lamps for the Exhibition. See "Official Notices" February 19th.

Edinburgh.—March 14th. Arc lamp carbons, box frames and covers, for one year. See "Official Notices" to-day.

Finchley.—March 12th. Free wiring proposals. See "Official Notices" to-day.

Gainsborough.—March 16th. Telephones and fire alarms for the U.D.C. See "Official Notices" February 19th.

Gravesend.—March 12th. Stores, &c., for the Electricity Department. See "Official Notices" to-day.

Hornsey.—February 29th. Stores and cables for the electricity works. See "Official Notices" February 12th.

Ilford.—March 8th. Stores for the Electricity Department. See "Official Notices" to-day.

Ilford.—March 22nd. One 1,000-KW. steam dynamo, switchboard work, condensing plant, water purifying plant, pipe work, cables, &c. See "Official Notices" to-day.

Kilmarnock.—February 29th. Pipework, lamps, feeders, switch-pillars, meters, &c. See "Official Notices" February 12th.

Loughborough.—March 12th. Dryback boilers, condenser, and battery for the electricity works. See "Official Notices" to-day.

Manchester.—March 1st. The Manchester Dock and Warehouse Extension Co. wants tenders for 25 electric hoists and 10 electric fixed cranes. See "Official Notices" January 29th.

Manchester.—March 7th. Stores for the Tramway Department. See "Official Notices" to-day.

May-Oatway Installations.—Wiring premises on this system at Greenock. See "Official Notices" to-day.

Metropolitan Asylums Board.—March 8th. Tenders are invited for fire alarm and telephone installations at Caterham. See "Official Notices" February 19th.

St. Annes-on-the-Sea.—February 27th. Steam dynamo. See "Official Notices" February 12th.

Salford.—February 29th. Stores, &c., for the Electricity Department. See "Official Notices" February 19th.

Snowdon.—February 29th. 1¾ miles of 36 in. diameter steel piping for the Portmadoc and North Wales Co.'s power station. See "Official Notices" February 12th.

South Shields.—March 12th. The Corporation invites offers for the lease of certain tramways. See "Official Notices" January 15th.

Spain.—March 20th. Tenders are being invited by the Spanish Ministry of Post and Telegraphs for the concession for the establishment and working, during a period of 20 years, of a telephone exchange in the town of Figueras. Tenders are to be sent to La Direccion General de Correos y Telegrafos, Carretas, 10, Madrid, whence particulars may be obtained.

Spain.—March 21st. Electric tramways in the town of Seville. See this column for February 19th.

Spain.—March 28th. Tenders for the lighting of the town of Plasencia.

Stepney.—March 14th. 1,000-KW. steam turbine-driven double current generator, Babcock boilers, economisers, induced draught, piping, &c. See "Official Notices" to-day.

Stourbridge.—February 26th. Engines and dynamos, boiler, booster, crane and battery, for the U.D.C. See "Official Notices" February 12th.

Sunderland.—February 26th. Crane and battery. See "Official Notices" January 29th.

Wallasey.—March 16th. A.C. transformers for two years. See "Official Notices" to-day.

Weymouth.—March 7th. Lighting the Corporation's generating station, and supply of meters. See "Official Notices" February 19th.

Wimbledon.—March 18th. Stores for the Electricity Department. See "Official Notices" February 19th.

Wrexham.—March 12th. Stores for the Electricity Department. See "Official Notices" February 19th.

CLOSED.

Battersea.—The B.C. has accepted the tender of Messrs. C. A. Parsons & Co. for a 750-KW. steam turbine dynamo at the central electric generating station for £4,890.

Bradford.—The Corporation has placed an order with the British Westinghouse Co. for a 1,000-KW. direct-current E.T. generator, together with field rheostat and other auxiliary apparatus. The generator will be vertically-divided, and will run normally at 550 volts, 85 r.p.m. This is a repeat order, and the machine will be exactly similar to the generators already supplied to the Corporation by the same company.

Brush Car Contracts.—The Brush Electrical Engineering Co. has secured the following contracts :—

J. G. White & Co. (for Aberdeen Suburban Tramways).—Six double-deck cars with single trucks.
Manchester Corporation.—Ten pairs bogie trucks for electric tramcars.
Gravesend and Northfleet Tramways Co.—Two "one-man control" cars complete with trucks and electrical equipment.

Canvey Island Tramways.—The contract for power-house equipment, six cars, motors and trucks and overhead equipment at £14,250, has been placed with Messrs. Bruce Peebles & Co., Ltd.

Cardiff.—The tender of Messrs. Siemens for a new engine and generator of 500-H.P. at £3,390 has been accepted by the Electrical Committee.

Croydon.—The Council has accepted the tender of Messrs. Dorman, Long & Co., of Middlesbrough, for the finished steel work for the extension of the power station.

Enniscorthy Asylum.—Out of 73 tenders submitted to the board for installing plant for lighting and power purposes (Mr. H. T. Harris, Dublin, consulting engineer), the following have been accepted :—

Messrs. Thos. Parker, Ltd.—Generator, motor-generator, &c.	£599
British Westinghouse Co.—Motor and motor pumps	347
The Pfluger Accumulator Works.—Accumulators	248
Messrs. Porte & Co., Dublin.—Switchboards	156
Wiring, &c.	753
B.I. & Helsby Cables Co.—Overhead wires and steel poles	636
	£2,734

Glasgow.—The T.C. has accepted the offer of the Electrical Co., Ltd., for six motor-generators, to be put down in one or other of the sub-stations connected with the department, at £9,958.

Heckmondwike.—The U.D.C. has accepted the tender of the Brush Electrical Co. for the supply of motors on hire.

Kingston-on-Thames.—The Guardians have accepted the tender of Messrs. Chas. Oldridge & Sons, Kingston, at £2,074 for installing the electric light in the Infirmary.

London.—The London County Council, on Tuesday, again adjourned the question of accepting a tender for the conversion of the Brixton—Streatham cable line to electric traction. The list of tenders appeared in this journal a week ago. At the same meeting the following contracts were settled:—

1.—Boiler Feed Pumps for Greenwich Power Station.

J. C. Lyell & Co., London ..	(incomplete) £3,090
Lowmoor Iron Co., Bradford	3,410
C. A. Musker, Ltd., Liverpool	3,545
J. G. Moore, Hartlepool	3,550
John Cochrane & Co., Glasgow ..	(accepted) 3,618
Bever, Dorling & Co., Bradford	£ 3,658
Phœnix Dynamo Co., Bradford	3,710 to 3,876
Bruce Peebles & Co., Edinburgh	3,751
Campbell Gas Engine Co., Halifax	3,751 and 4,405
Blake & Knowles Steam Pump Works, London	3,936 to 5,171
Frank Pearn & Co., Manchester	3,957
Johnson & Phillips, London..	3,977 to 4,125
Lancashire Dynamo and Motor Co.	4,157 to 4,978
Hunter & English, London	4,174
British Westinghouse Co.	4,255 to 5,792
Andrew Barclay, Sons & Co., Kilmarnock ..	4,357 and 4,488
Pratchitt Bros., Carlisle	4,380
British Thomson-Houston Co.	4,453 and 4,456
Goodfellow Engineering Co.	4,459
Coalbrookdale Iron Co., Shropshire	4,580
Mirrlees, Watson & Co., Glasgow	4,634 and 4,744
W. H. Bailey & Co., Salford..	4,731 and 4,887
Ernest Scott & Mountain, Ltd.	4,788 and 5,088
Arthur Koppel, London	5,018
Henry Berry & Co., Leeds	5,022
Worth, McKenzie & Co., Stockton-on-Tees ..	5,156
Worthington Pump Co., London	5,161
R. W. Blackwell & Co., London	5,312 to 5,470
Rhodes Electrical Manufacturing Co., London..	6,580
Crow, Harvey & Co., Glasgow	6,680 and 6,980
Electrical Mining Co., Derby	6,691
Baker's Patent Appliances Co., Scarborough ..	6,734
Mather & Platt, Ltd., Manchester	8,483

2.—Fuel Economisers for Greenwich Station.

James Carter & Sons, Stalybridge (not to specification)	£2,518 8
Arthur Lowcock, Ltd., Shrewsbury	3,060 8
E. Green & Son, Ltd., Wakefield (accepted)	3,071 6
The Clay Cross Co., Chesterfield	3,150 15
Goodbrand & Co., Stalybridge	3,164 14

3.—Railway Turntables for Greenwich Station.

Graham, Morton & Co., Leeds (not to specification) ..	£721 0
The Patent Shaft & Axletree Co., Wednesbury.. ..	791 0
Ransomes & Rapier, Ltd., London (accepted)	805 0
Cowans, Sheldon & Co., Ltd., Carlisle	808 10
Hurst, Nelson & Co., Ltd., Motherwell	840 0
Dick, Kerr & Co., Ltd., London	854 0
Isca Foundry Co., Newport, Mon.	857 10
Heenan & Froude, Ltd., Worcester	875 0
T. Larmuth & Co., Salford	910 0
Alex. Penney & Co., Salford	910 0
J. Hitchen & Son, Halifax	1,018 10
J. & F. Howard, Bedford	1,050 0
The Whessoe Foundry Co., Ltd., Darlington	1,050 0
The Coalbrookdale Co., Ltd., Shropshire..	1,239 0
R. Hudson, Leeds	1,253 0
do.	1,393 0
J. Musgrave & Sons, Ltd., Bolton	2,149 0

4.—Wiring Deptford Fire Station.

F. Hodgson & Co. (accepted)	£185 17
Alliance Electrical Co.	198 7
A. H. Marshall & Co.	210 0
Duncan, Watson & Co.	226 0
L. Sunderland & Co.	238 0
F. J. Coleby & Co.	238 10
Oliver, Clarke & Co.	240 0
Tyler & Duncan	240 0
W. H. Johnson	251 19
Drake & Gorham, Ltd.	254 10
Laing, Wharton & Cunnington	261 9
Barlow & Young	280 0
National Electric Construction Co...	298 19

5.—Wiring Old Kent Road Fire Station.

F. Hodgson & Co. (accepted)	£157 0
Alliance Electrical Co.	181 0
Duncan, Watson & Co.	202 0
A. H. Marshall & Co.	206 0
W. H. Johnson	211 0
L. Sunderland & Co.	223 0
Tyler & Duncan	225 0
F. J. Coleby & Co.	227 0
Oliver, Clarke & Co.	239 0
Laing, Wharton & Cunnington	240 0
Drake & Gorham, Ltd.	241 0
Barlow & Young	260 0
National Electric Construction Co.	278 0

Preston.—The Tramways Committee on February 18th accepted the tender of Messrs. Dick, Kerr & Co., Ltd., for steam and feed piping at £891.

FORTHCOMING EVENTS.

Friday, February 26th.—At 5 p.m. Physical Society. "A New Dilatometer," by Mr. Borniksen; "A Quartz-thread Vertical Force Magnetograph," by Dr. W. Watson; "On Stresses in a Magneto-static Field," by Mr. G. W. Walker; "Some Hints on the Preparation of Diagrams," by Dr. W. Watson.

At 7.30 p.m. North-East Coast Institution of Engineers and Shipbuilders. Meeting at Newcastle. "Technical Education, with Special Reference to the Admiralty System," by Mr. B. C. Laws. Discussion, &c., on previous papers.

At 8 p.m. Institution of Civil Engineers (Students). "Boiler-house Design," by Mr. L. G. Crawford.

At 9.0 p.m. Royal Institution. Mr. Alexander Siemens on "New Developments in Electric Railways."

Institution of Electrical Engineers (Manchester). Annual dinner.

Northampton Institute, Clerkenwell. Distribution of prizes by Lord Kelvin, and Conversazione.

At 8 p.m. Electro-Harmonic Society. (Ladies' Night.)

Saturday, February 27th.—At 3 p.m. Royal Institution. Lord Rayleigh, F.R.S., on "The Life and Work of Stokes." (Lecture II.)

Association of Engineers-in-Charge. Concert and dance.

At 6.30 p.m. Northampton Institute. Annual Conversazione.

Tuesday, March 1st.—At 7.30 p.m. Institution of Electrical Engineers (Manchester). Mr. H. L. Kirker on "The Mersey Railway—Multiple Control System."

At 3 p.m.—National Electrical Manufacturers' Association. Annual meeting at the Hotel Cecil.

Wednesday, March 2nd.—At 7.30 p.m. Institution of Electrical Engineers (Students). "The Determination of the Correct Proportion of Condensing Plant in a Central Station," by Mr. P. V. Hunter.

At 5 p.m. Royal Institution. Prof. H. L. Callendar, F.R.S., on "Electrical Methods of Measuring Temperature." (Lecture II.)

Thursday, March 3rd.—At 8 p.m. Civil and Mechanical Engineers' Society. "Dynamo and Motor Testing," by Prof. C. F. Smith.

At 8.30 p.m. Röntgen Society. Presidential address—"Some Laboratory Notes of the past Six Months."

Friday, March 4th.—At 8 p.m. Junior Institution of Engineers. "Some Practical Notes on Electric Storage Batteries," by Mr. G. C. Allingham.

Saturday, March 5th.—At 9.30 a.m. Institution of Electrical Engineers (Students). Visit to Messrs. Sir J. I. Thornycroft & Co.'s works, Chiswick.

At 3 p.m. Royal Institution. Lord Rayleigh on "The Life and Work of Stokes." (Lecture III.)

At 7.30 p.m. Glasgow Technical College Scientific Society. "British Competition and Manufacture," by Mr. M. Pickstone.

NOTES.

Electro-Harmonic Society.—To-night is a Ladies' Night at the Electro-Harmonic, and a large muster is expected. Lord Claud Hamilton, the chairman of the Great Eastern Railway, who has had to think much about electrification questions of late, and may have to think much more in the near future, notwithstanding his temporary expedient of longer platforms and longer trains, is expected to be in the chair. The programme announces songs by Mrs. Helen Trust and Mr. Robert Hilton, instrumental music by Mr. A. E. Izard (piano), Mr. T. E. Gatehouse (violin) and Mr. B. C. Goodhead ('cello), and an orchestra. The miscellaneous items include character sketches from Dickens by Mr. Ernest Cherry, humorous sketches by Mr. Ulph Smith, and humorous imitations by Mr. J. M. Campbell. This is the last Ladies' Night of the season.

Magnetism and Phosphorescence.—M. Gutton, in communications to the Academy of Sciences, Paris (see *Comptes Rendus*, February 8th), has shown that the lines of force of a non-uniform magnetic field enhance the brightness of phosphorescent sulphide of calcium. Moreover, the magnetic effect produced by convection currents of electricity acts in a similar way on the sulphide.

Electricity in Mines.—In reply to a question by Mr. Markham, with regard to which no oral answer was required as to whether the Home Secretary would give any opportunity to the House of Commons to discuss the departmental recommendations of the Electricity in Mines Committee's report, Mr. Akers Douglas has placed an answer on the minutes to the effect that he sees no reason for departing from ordinary Parliamentary procedure in the matter. He says he appointed the Committee to advise him on the subject of the use of electricity in mines for the purpose of his duty under the Mines Regulation Acts; and it would be open to any hon. member to discuss on the Home Office vote the action which he might take on the recommendations made by the Committee.

"Everyday Electricity."—Our spirited young monthly contemporary is nothing if not up to date. In the March issue, which appeared a week ago, the electrification of the North-Eastern Railway is briefly described, and there are a number of short articles in popular language on electric lighting, cooking and heating, and the care of electrical apparatus, in addition to the usual notes and comments. The special feature of the issue, however, is an electromobile supplement dealing with the Crystal Palace exhibits, and various matters relating to the main subject. Altogether, the issue reflects credit upon its authors and editors.

The McMillan Memorial Fund.—A notice has been issued by the president, Mr. Robert Kaye Gray, to members, associate members, associates and students of the Institution of Electrical Engineers, asking them to forward subscriptions to the McMillan Memorial Fund. We are sure that the support which has been asked for will be ungrudgingly given.

(*Continued on page* 347.)

WESTINGHOUSE GAS ENGINES.

Among the first to realise the enormous advantage of utilising inflammable gases by combustion in the cylinder of the engine, instead of under the boilers, was Mr. George Westinghouse. Extensive investigations and experiments were conducted by him and his assistants, with the result that a type of gas engine, widely different from any types at that time prevalent, was developed and put on the market a number of years ago.*

A characteristic of the original design, retained in the engine at the present day, that makes close regulation possible, is the controlling of the charge of explosive mixture according to the load, so that a constant series of explosions without intermission is obtained. In the usual method known as the "hit-and-miss" system, the explosion is omitted at every few cycles, according to the load on the engine; thus the speed varies continually between the maximum and minimum allowed by the governor. Uniformity of revolution is also promoted by building engines with two or three, instead of a single, cylinder. These principles are employed in single-acting vertical engines with two cylinders for sizes up to 50 H.P., and with three cylinders for sizes from 50 H.P. to 250 H.P.; above this size similar principles are employed with double-acting, instead of single-acting engines. This effects considerable economy in material, and makes possible the production of a commercial engine up to very large sizes at reasonable cost. The standard double-acting vertical design is made in sizes up to 1,500 B.H.P. Horizontal double-acting engines both below and above 1,500 B.H.P., working on similar principles to the vertical engines, are also made.

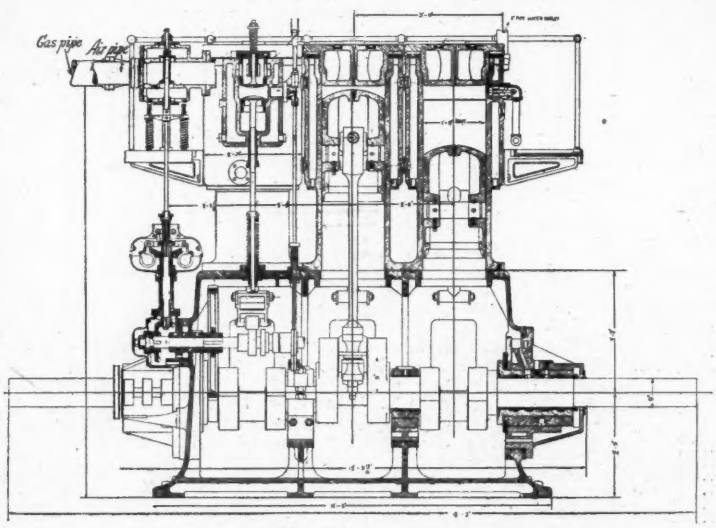


Fig. 1.

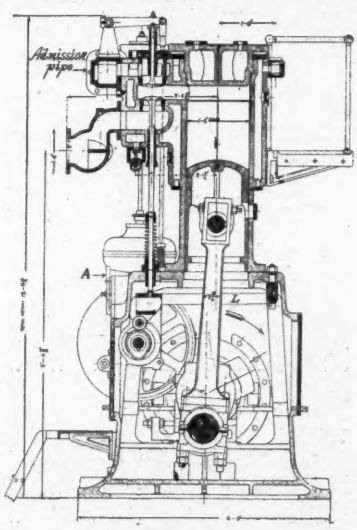


Fig. 2.

Figs. 1 and 2 represent respectively a longitudinal and a transverse section of a Westinghouse three-cylinder vertical single-acting gas engine, rating at 250 B.H.P. with producer gas. Referring to fig. 1, the gas and air enter the mixing valve through the gas and air pipes shown to the left hand in the figure. From the mixing valve the mixture passes to the main admission pipe at the same level. This pipe runs alongside the three cylinders at their upper ends in proximity to the admission valves. The arrangement of the latter will be seen more clearly in fig. 2. They are of the mushroom type, operated by vertical rods driven from the main cam shaft inside the frame of the engine, the valves being opened by the movement of the rods and closed by spring action. A spiral spring further serves to maintain the roller on the end of the operating rod in contact with the cam.

The exhaust valves, of similar type, are operated direct from the same cam shaft. A horizontal lever L (see fig. 2) has its fulcrum inside the engine frame at the side opposite the cam shaft. This lever terminates in a roller running on the exhaust cam of the cam shaft, and maintained in contact with it by spring pressure from above; thus the lever is moved up and down by the rotation of the cam, and in turn operates the stem of the exhaust valve, which is continued downward from the valve box through the engine frame, its lower end resting on the lever.

It will be noticed that there is but one cam shaft for the operation of all the valve and other motions. This cam shaft is inside the crank case of the engine, being driven from the main shaft by toothed gearing with a ratio of 2 to 1. It is lubricated by splashing of the cranks in the oil contained in the crank case. The governor, which is of the fly-ball type, cased in, and sufficiently sensitive to allow of very close regulation, is driven by a vertical shaft and gearing off the same cam shaft. It controls the speed of the engine by actuating a throttle valve on the admission pipe, thus altering the quantity of explosive mixture drawn in at each suction stroke without varying the quality. This method of governing is so accurate that Westinghouse gas engines are direct coupled to both continuous and alternating current generators operated in parallel in the same manner exactly as steam engines are operated. The explosive charges are electrically ignited by the making and breaking of an electric current between suitable contacts in the compression space, the igniter being actuated by a simple tripping device.

By the method of regulating the quantity of explosive mixture according to load requirements, an explosion is obtained at each revolution with the two-cylinder single-acting type, and each two-thirds of a revolution with the three-cylinder single-acting type.

The engines are started with compressed air. By turning one of the three handles outside the crank case (A, fig. 2), the cams from which the valves of one of the cylinders are driven are displaced, and the rollers on the end of the valve operating rods engaged with an auxiliary set of cams, the effect of which is to open the admission and exhaust valves at each revolution instead of at each second revolution. The cylinder is cut off from the gas supply and connected to a compressed air tank, so that with the valve functions altered, this cylinder acts as a simple compressed-air motor. As soon as explosions take place in the other cylinders, the compressed air is cut off, the cams are reset, and the starting cylinder comes into regular operation. The process of starting up, even in a large engine, can be done within one minute and by one man, an important advantage over the steam engine, which requires a much longer time to warm up and start.

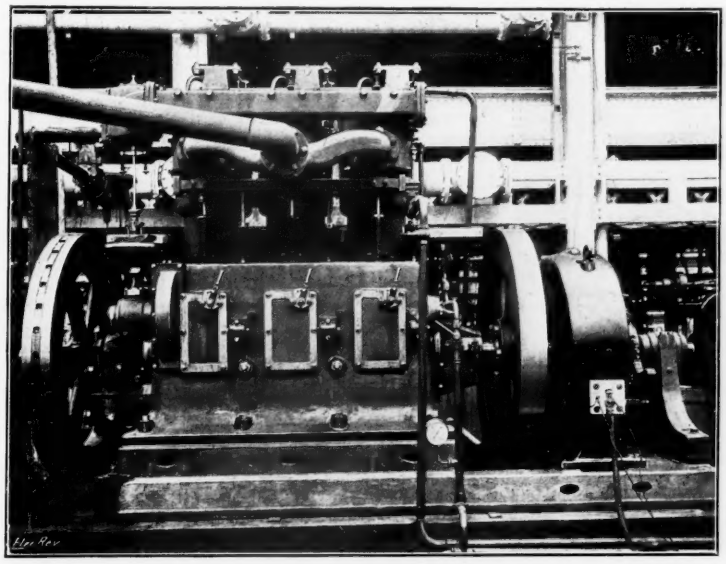
The design of the Westinghouse engine allows a moderately high speed, which constitutes an essential advantage.

The single-acting engines are used with natural gas, illuminating gas, and gasolene or petrol, as fuel. The double-acting engines also run on coke-oven gas, and blast-furnace gas. It is generally recognised that gas engines using producer gas made from a cheap quality of coal, form the most economical source of artificial power, and an extended use of an engine using this gas, and giving the

* See description in the Electrical Review, July 28th, 1899, pp. 132—135.

same regularity in speed and reliability of operation as a good steam engine, may be anticipated with certainty. The successful utilisation of coke-oven gas and blast-furnace gas direct in gas engines also opens up an enormous and growing demand for such engines, and will effect an enormous saving in the world's fuel supply.

In the case of the vertical double-acting engine designed by the Westinghouse Co. there are two double-acting cylinders mounted on the top of massive A frames, one on either side of the driving pulley or electric generator and fly-wheel. The upper parts of the A frames form guides for the crossheads, while the cranks revolve in the open lower part of the frames. The cranks are of the disc overhung type with the bearings within the A frames. The main shaft drives by means of worm-gearing a vertical spindle, which in turn actuates the main cam shaft, the latter being supported by brackets bolted to the upper parts of the frames, and bearing cams for the operation of admission and exhaust valves for the two ends of both cylinders.

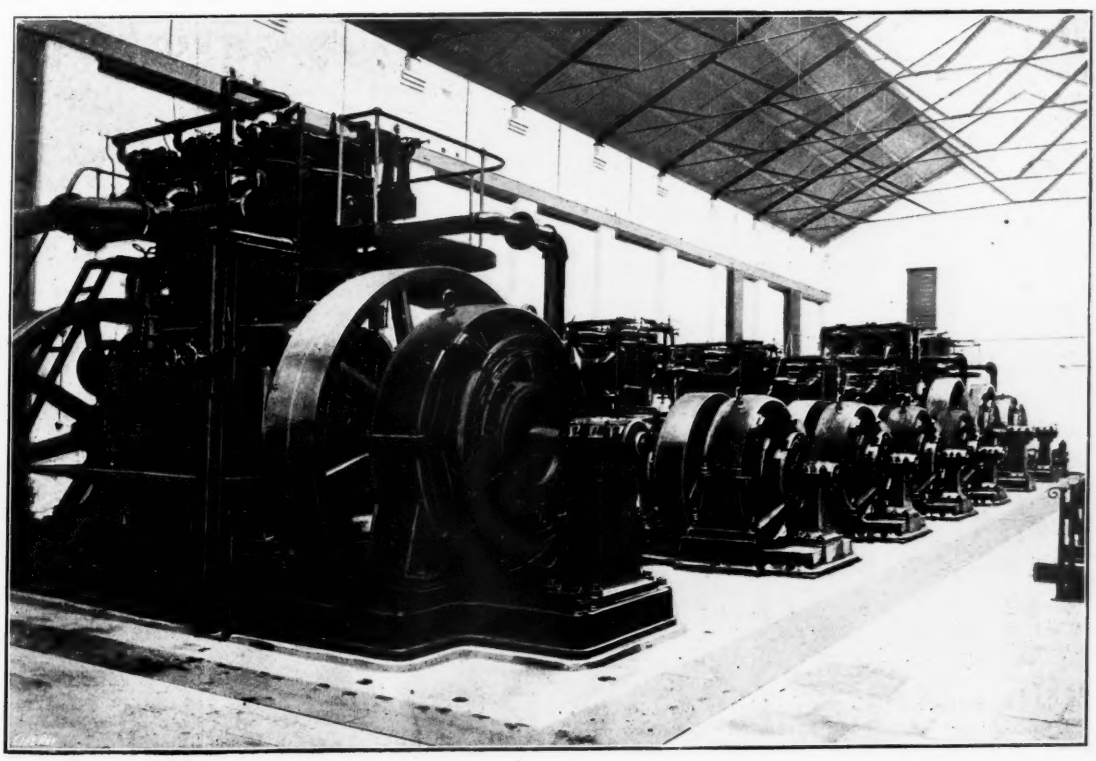


Latest Type of Westinghouse 3-cylinder Gas Engine, Supplied to His Majesty King Edward VII. for Sandringham.

As these double-acting engines are designed for large powers, and the amount of heat generated in the cylinders is very great, the cooling has been thoroughly worked out. The cylinders, cylinder heads, pistons and exhaust valves are all water-cooled by simple and efficient methods.

In general appearance this vertical double-acting design of gas engine strongly resembles that of a cross-compound steam engine.

The British Westinghouse Co., who manufacture the Westinghouse gas engine at their Manchester works, have installed some characteristic gas plants. One of the first large plants put down in this country was for the Walthamstow Urban District Council, at Hoe Street, Walthamstow. This plant started with three 100-H.P. direct-coupled gas engine electric sets, to which a fourth set was very soon added. A full description of this installation was published in our issue of October 18th, 1901. The demand grew so rapidly that a little later the capacity was increased by three 250-H.P. sets, which are now running. The next increase, which has already been arranged for, will consist of three 265-H.P. sets, making in all a plant of 10 generating sets. This plant has been most successful, has never had a shut-down, and is furnishing electrical energy for lighting and power with a remarkably small consumption of coal. Other plants, consisting principally of central stations for light and power used by prominent manufacturing companies, are those of Cadbury Bros., Bournville, near Birmingham; the Birmingham Small Arms Co., Birmingham; and the Great Western Railway Co., Swindon. All of these plants, as well as many others, have been increased by repeat



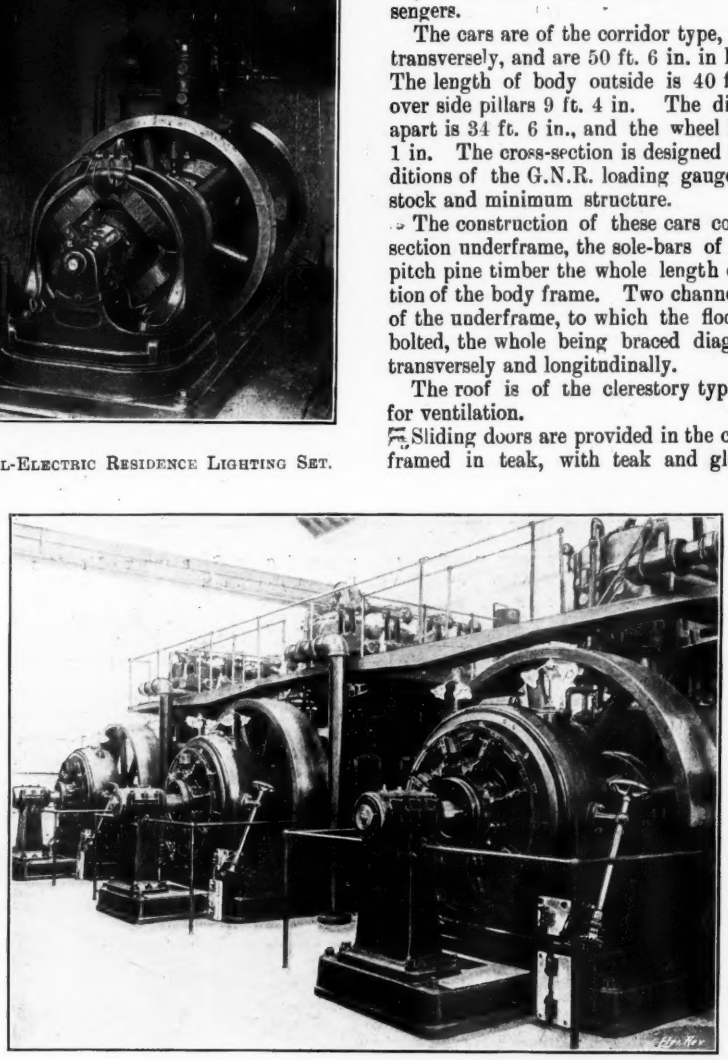
Walthamstow Electricity Works: Four 100-H.P. and Three 250-H.P. Westinghouse Gas Engines Driving Helios Dynamos.

orders, resulting from the satisfactory operation of the engines.

Other large Westinghouse gas engine installations now being installed are for the Midland Railway Co., the Buenos Ayres Great Southern Railway Co., Buenos Ayres Western Railway Co., Tweeddale and Smalley, South Staffordshire Mond Gas Co., Limerick Urban District Council, Faversham Urban District Council, Honley Urban District Council, &c.

Westinghouse Petrol-Electric Residence Lighting Set.

Westinghouse gas engines in the smaller sizes are largely used for country residence lighting, on account of their simplicity and reliability. A glance at the figure above will show their compactness, as compared with horizontal sets, belt driven or direct coupled, while their silent running is an especial advantage for this class of work. In most of these plants petrol is used as fuel.



Birmingham Small Arms Co : 3 250-h.p. Westinghouse Gas-Electric Sets.

THE GREAT NORTHERN AND CITY ELECTRIC RAILWAY.

(Concluded from page 184.)

The power is conveyed to the motors on the cars by means of two insulated rails per track, one placed 2 in. higher than and outside of each track rail. The rails are of channel section, weighing 80 lbs. per yard, and are rolled to about 42-ft. lengths. They are of low carbon steel of a special quality, having a conductivity 14 per cent. of that of pure copper. These rails are supported on earthenware insulators 10 in. outside of the gauge, carried on spindles supported by cast-iron brackets fixed to the sleepers. The system of collector rails is divided up into four sections, fed independently from the generating station, and the rails of the up and down tracks are interconnected through circuit-breakers at different points to equalise the currents in the two pairs of rails. The track consists of 85-lb. flanged rails, laid through the tunnels on longitudinal timbers and rolled steel chairs; as it carries no current it is not bonded. Detail drawings of the rails and collector shoes are given on p. 347.

As previously mentioned, each train consists of three motor cars and four trailer cars, one motor car being at each end of the train and one in the centre. The seating capacity of the motor cars is 54, and of the trailer cars 56 passengers.

The cars are of the corridor type, the seats being arranged transversely, and are 50 ft. 6 in. in length over the buffers. The length of body outside is 40 ft. 8 in., and the width over side pillars 9 ft. 4 in. The distance of bogie centres apart is 34 ft. 6 in., and the wheel base of the bogies 6 ft. 1 in. The cross-section is designed to comply with the conditions of the G.N.R. loading gauge for maximum rolling stock and minimum structure.

The construction of these cars consists of a steel channel section underframe, the sole-bars of which are filled with a pitch pine timber the whole length of the car for the reception of the body frame. Two channels run the whole length of the underframe, to which the floor members are securely bolted, the whole being braced diagonally and trussed both transversely and longitudinally.

The roof is of the clerestory type, with swinging sashes for ventilation.

Sliding doors are provided in the centre, and at both ends, framed in teak, with teak and glass panels. They are suspended from the top by brass hangers carrying friction rollers. The centre doors cannot be opened from the interior of the car; they are intended for use at the termini only, where they are opened by special porters.

The entrance platforms are fitted with automatic locking gates on each side. Each platform has a permanent vestibule front with a double swing door. Every two adjacent gates are arranged so that they can be easily controlled by one man standing in the gangway.

"Scissors" Crossing at Drayton Park. (See p. 347.)

The interior finish is of teak, panelled with mahogany; these panels between the windows are inlaid with sycamore and pressed teak moulding. The other mouldings

are of teak, the roof being finished with Lincrusta millboard.

The electric lighting consists of 15 16-c.p. lamps, in fittings arranged to carry cut-glass pear-shaped globes of an artistic appearance.

A portion of the car, 2 ft. 10 in. long, at one end is partitioned off for the reception of the electric control apparatus. This compartment is lined with sheet-iron and asbestos, to ensure complete protection against fire from any of the electrical gear. An oil lamp is fitted over the inside of each doorway, for use when the current is cut off.

The motor-cars are carried on bogie trucks of the McGuire type, having driving wheels 36 in. in diameter.

The trailer cars are of the same general design and construction as the above, except that the platforms are not vestibuled, but are fitted with an iron screen, 4 ft. 6 in. in height, carried round the end of each gangway; they are provided with similar wrought-iron locking gates.

The Brush "Heavy Service" trucks, type "E," have been provided for the trailer cars. These trucks have cast-steel sides, inside brakes, and a swing bolster which ensures very steady running. The wheels are steel tired, with wrought-iron centres.

Central radial spring couplers, which also act as buffers, are employed.

Collapsible iron gates are fitted to the opposite corners of each car, so as to be interchangeable when coupling the cars. These are to rail off the spaces between the coaches. Hinged cross-over plates are used to provide a gangway between the adjacent platforms, the latter being protected by wrought-iron fencing.

The cars were supplied by the Brush Electrical Engineering Co., Ltd., of Loughborough, and the Electric Tramway and Carriage Works, Preston.

On each truck of the motor-cars is mounted one B.T.-H. series-wound direct-current geared motor, operating at approximately 550 volts, current being collected by four collector shoes per truck.

The capacity of each motor is 125 H.P., rated on the standard B.T.-H. basis of 75° C. rise in temperature above the surrounding air after one hour's run on full rated load. The gear is of steel, machine cut, and is enclosed in a waterproof gear case.

The motors will be controlled, as previously mentioned, by the multiple unit system of the British Thomson-Houston Co., Ltd., by which the whole train may be operated from any one of several master controllers, or may be broken up and operated in smaller units. Each motor-car constitutes a complete unit, and can be individually operated.

The multiple unit control system consists in general of two parts:—First, a number of electrically-operated switches, called "contactors," constituting the series-parallel motor controller, which effect the different combinations of the motors, and vary the starting resistance in circuit with them, and a separate electrically-operated reverse switch; second, two master controllers, one located at each end of each motor-car, which operate the motor-controlling switches and reverse switch. A cable connected to each master controller and to the electrically-operated switches runs the entire length of the train, whether the cars are motor-cars or trailer coaches, with suitable couplers for connecting the cars.

Incline leading to G.N. Ry. G.N. Ry. above retaining wall.

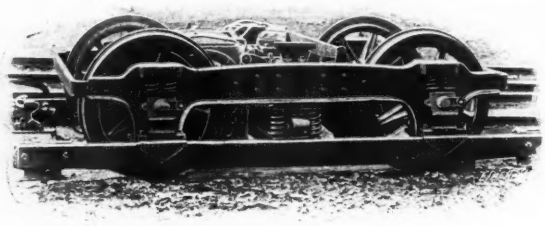
Entrance to Northern Tunnels at Drayton Park.

The synchronous action of the "contactors" on all the cars with the movement of the master controller handle ensures similar resistance connections and motor combinations on all the cars at all times. The position of the master controller handle indicates to the operator the exact position of the motor controllers on all the cars, the proper number of points being provided on the cap-plate. The rate of movement of the motor controllers, and consequently the amount of current taken by all of the motors is, therefore, under his immediate control, and the motorman is able, at will, to instantly utilise the full power of the motors in either direction in an emergency.

The electro-magnetic switches, which are controlled by the master controllers mentioned, are situated in a separate compartment on each motor-car, arranged for easy access. These compartments have been lagged with sheet-iron over uralite, and all the cables have fire-proof insulation, and are supported on earthenware cleats enclosed in sheet-iron trouging where they are located under the car, with a view to making the whole absolutely non-inflammable. For further details of the

Motor-car and Train Standing in Drayton Park Station.

controlling apparatus on these trains we may refer our readers to the illustrated description which we published in our issue of December 13th, 1901, pp. 972-975. A fully

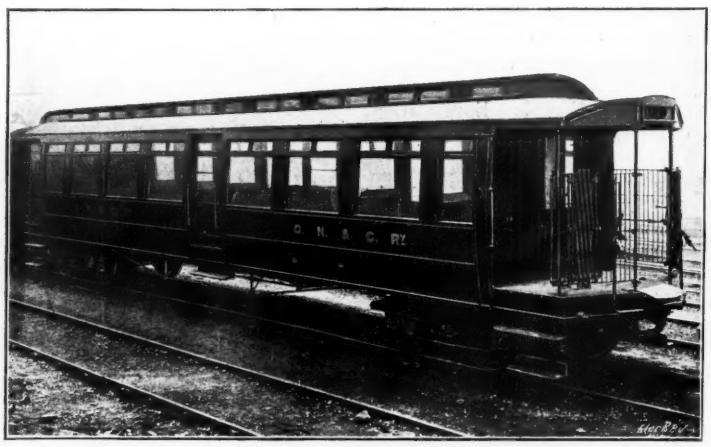


McGuire Bogie-Motor Truck.

illustrated description of the electric lifts also appeared in the same issue, pp. 977-979.

The trains are equipped throughout with air-brake apparatus of the Westinghouse quick-acting type, each motor-car carrying a motor-driven B.T.-H. air compressor, reservoir, &c. There are also conductors' emergency cocks at the ends of each car for applying the brake in case of need. Efficient hand-brakes are provided on each motor-car, and can be operated from either platform.

All lighting circuits are carried in iron tube, and the tunnels are provided with a lamp every 100 ft. The passenger stations are lighted on the rail and street level by B.T.-H. enclosed arc lamps, and station switches are fixed which control the B.T.-H.-Edison incandescent lamps in the tunnel, halfway to the next station in each direction. The lamps are five in series, and the circuits are run so that there is never more than the voltage of one lamp between two wires in the same iron pipe. The current for lighting the tunnels and passenger stations is supplied through special sets of lighting mains direct from the power station switchboard. Special throw-over switches are provided to take this current from the conductor rails at any time when the lighting cables are not charged.



Trailer Car.

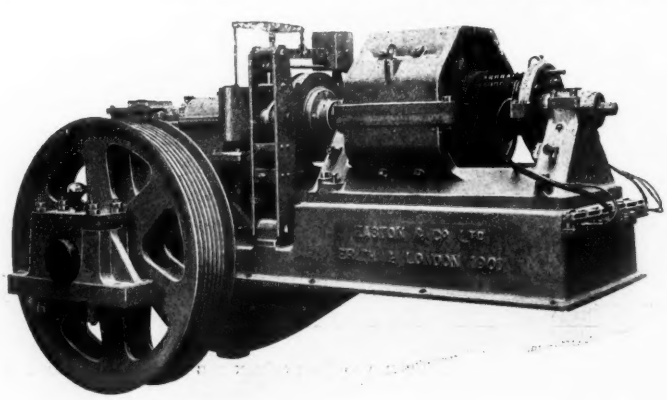
Repair shops, equipped with all the necessary tools and driven by a single motor, are situated at the side of Drayton Park Station. Provision is made for receiving power either from the rails or from the lighting main.

In the large car depôt ample facilities are provided for inspecting and replacing the motors, and an exceptionally convenient type of screw truck elevator is in use in the inspection pits. Each of these hoists has two platforms, and is placed in the line of a full-gauge track running along the bottom of the pit. The upper platform carries a pair of rails, completing the ordinary track at the ground level, and the lower platform carries rails which perform a similar function for the low-level track. When a truck is to be removed from a car, the latter is run over the elevator until the truck is on the upper platform; the car-body is then jacked up, and the truck is lowered by means of the elevator to the low-level track, while the lower platform sinks out of the way. The truck on reaching the low level can be run into the repair shop and quickly replaced by another truck. Three such elevators are fixed in each pit, so that any truck on the three motor-cars included in an ordinary train can be dealt with, without moving the train more than about 35 ft.; the two platforms are required in order that when the elevators are in their normal position, a clear line of rails shall be provided at the lower level, on which the trucks can be run. The platforms are carried on four steel screw columns, working in nuts at the corners of the platforms; the pitches of the screws working the upper and lower platforms are dissimilar, so that while the upper platform sinks from the upper to the lower level, the lower platform sinks only half as far. Each lift is worked by a small enclosed motor.

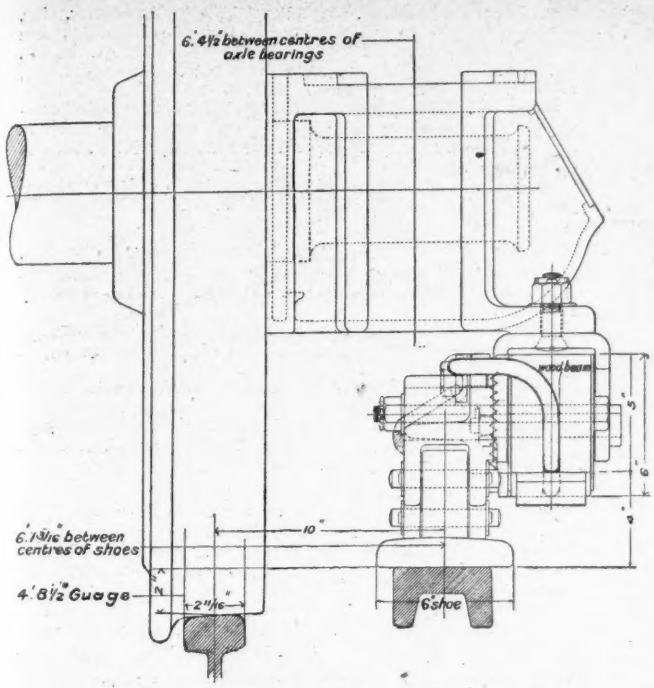
Since the last instalment of this article appeared, the railway has been informally opened for public traffic, and has been at work for the past fortnight without mishap.

The engineers for the railway from the City to Drayton Park are Sir Douglas Fox & Partners, represented on the work by Mr. D. L. Hutchinson. The later portion of the system, from Drayton Park to Finsbury Park, including also the repair shops and car-sheds, was carried out by the Great Northern Railway Co., under their chief engineer, Mr. Alexander Ross, and Mr. H. W. Sadler. The contractors for the whole of the railway are Messrs. S. Pearson & Son, Ltd., one of whose directors, Mr. E. W. Moir, has had charge of the work during its execution. Messrs. Pearson & Son, as already mentioned, are responsible for working the line for three years. The general control and engineering of the railway are in the hands of Mr. R. P. Brousson, who took part in the installation of electric traction on the Central London Railway, and was electrical engineer for Messrs. Pearson during the construction of the Great Northern and City Railway. Messrs. B. Everett and H. Japp were agents for Messrs. Pearson in charge of the southern and northern sections of the work during construction.

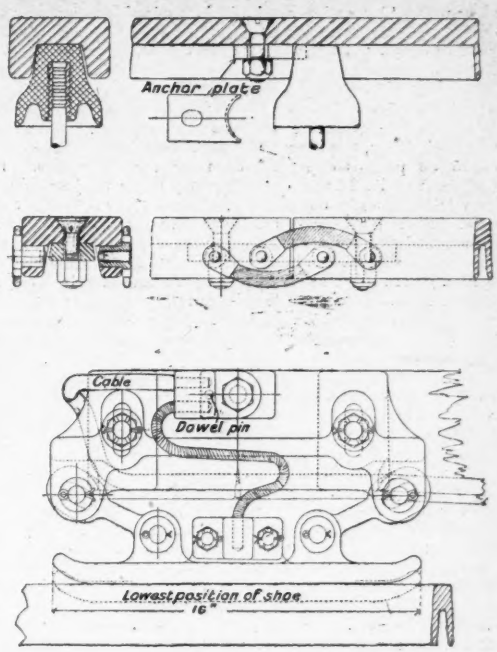
The sub-contractors for the whole of the electrical equipment of the power station, line, rolling stock and lighting services, were the British Thomson-Houston Co., Ltd., of Rugby. The whole of the engineering work for this company was under the direction of Mr. A. H. Walton, manager of the "heavy traction department," assisted by Messrs. Winkfield, Dundas and Thomas.



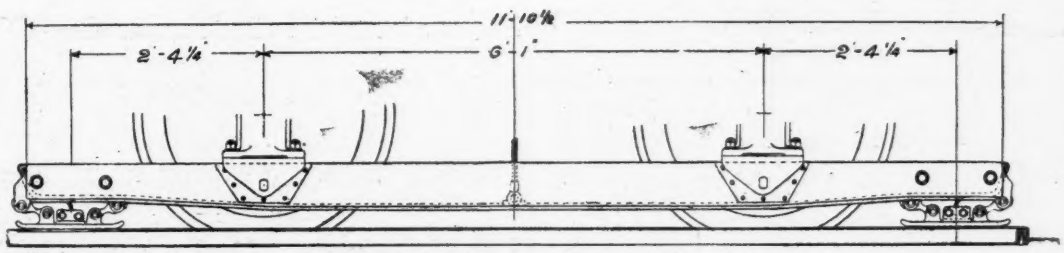
Winding Gear of the Easton Electric Lifts.



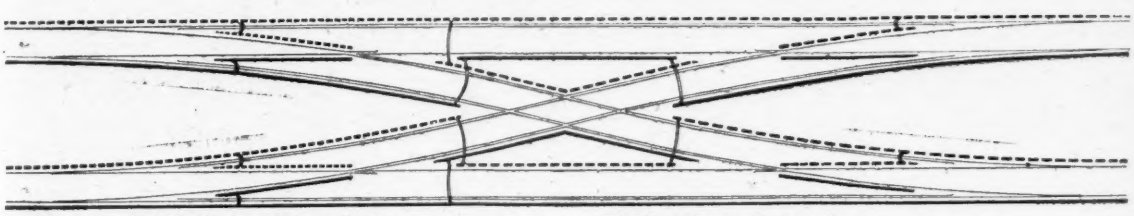
General Arrangement of Rails and Collector Shoe.



Bonding and Anchoring of Conductor Rail, and Elevation of Collector Shoe on Rail.



Arrangement of Collector Shoes and Beam.



Positive collector rails shown thus: ———— Negative collector rails shown thus: ..... Scale 30 ft. to 1 in.

Scissors Crossing at Drayton Park: Arrangement of Collector Rails.

We are indebted to Messrs. S. Pearson & Son, Ltd., for facilities to obtain photographs of the power station and on the railway; and to various members of their staff, as well, as to the respective sub-contractors, for kind and courteous assistance in the preparation of this article.

NOTES.

(*Continued from page* 341.)

Water Power and Coal.—Before the Royal Commission on Coal Supplies, sitting at Westminster, on the 17th inst., Prof. George Forbes gave evidence as to whether water power could be looked to as a means of economising the coal supplies of the United Kingdom. He said that no such economy could be depended upon in England, Wales or Ireland, but that there were several places in Scotland where water power plants of over 1,000 H.P. could be installed, which would lead to an appreciable saving in coal.

Appointments Vacant.—Clerk of works for the Bridlington electricity supply scheme; chief assistant at Barnsley electricity works (£150); lineman for the Southend electric tramways.

Annual Dinner of the G.E.C., Ltd.—On Saturday last the annual dinner of the General Electric Co., Ltd., took place at the Trocadero Restaurant. This event has become one of the noteworthy fixtures of the electrical year; it was attended by nearly 400 guests, including, besides members of the company's staff, very many of the consulting and central station engineers and other leading lights of the profession. Mr. G. Byng, chairman and founder of the company, presided.

An excellent repast was served, during which the Universal Orchestra performed selections of music, including the new "General Electric Company March," specially composed by Mr. Louis Hillier (a souvenir copy of which was presented to each of the guests).

After the loyal toasts had been duly honoured, the chairman proposed "The Imperial Forces." In his reply, Col. Crompton remarked that our Navy was evidently ready, for the Japanese Navy, which was modelled on our own, had given a good account of itself. He had left the War Office, with other members of the staff, owing to the introduction of the new system, which he believed to be founded on sound principles; the War Office, however, had done good work in the past.

The next toast was "The Staff." In proposing this, the chairman remarked that it was just 25 years since he, with Mr. Hirst and Mr. Max Byng, founded the company—25 years of uninterrupted progress. During the past year new branches had been founded abroad; the Robertson Works had been enlarged; the Peel Works, Manchester, had done well under Mr. Eckstein, and the Birmingham establishments under Mr. Boyes. The Witton Works were also prosperous, under the direction of Mr. Railing and Mr. Ide, and were making plant of the largest size, equal in working to Continental and American productions, but lower in price,

at a profit. The carbon works had received great encouragement during the year in the shape of large orders from the Government, municipalities and others; they would continue to fight, in the hope of some day obtaining that protection which was due to them in starting a new industry. Recently Mr. Hirst had booked an order for all the lift motors of the Underground Railway—340 in all—in face of severe American competition. With regard to the fiscal policy, the company thought they had a right to be heard, as 15,000 persons depended on them for sustenance. In their opinion, the livelihood of these people was in jeopardy through unrestricted foreign competition. With few exceptions, every piece of electrical apparatus which had been imported into this country during the last few years could have been made in this country and sold as cheaply as it was now being sold. He had been called by the ELECTRICAL REVIEW a selfish monopolist [We never did!—EDS.]; but he believed that under protection he could manufacture at lower prices than at present, and there would always be sufficient internal competition to prevent imposition upon the consumer. When protection came the company would be prepared to supply manufactured articles at lower prices than now rule. He exhorted the staff to work hard, in spite of the unjust competition to which they were exposed, and which, he believed, would shortly be removed.

Mr. W. White, responding for the staff, looked forward with pleasure to the era of protection, and remarked on the legislative restrictions which had handicapped the industry in the past, but in spite of which British firms had won their way to the front. He proposed the health of the directors, eulogising Mr. G. Byng, who started with a staff of one, and was now at the head of 15,000 persons; Mr. Hirst, a *persona grata* to all the staff; and "Merry Little Max." He also referred in cordial terms to Messrs. Eckstein, Railing and Bevis. Mr. Max Byng, in reply, remarked that the earnest work of the staff was ample protection. Mr. Hirst addressed his remarks mainly to the guests, on the subject of confidence in British products and in the abilities of the staff. During the last five or six years, workshops had sprung up equal to any in the world, and well adapted to regain the lead in manufactures. Referring to the lack of scenic beauties in the neighbourhood of Manchester and Witton, as compared with Lucerne, Buda-pest, &c., Mr. Hirst drew a humorous outline of a scheme for a motor track, an hotel, fancy dress balls, &c., to be provided for the delectation of engineers engaged in testing machinery, and concluded by proposing the health of "The Guests." Mr. R. W. Wallace, K.C., Mr. E. Manville and Mr. A. R. Phipps responded.

Lastly, Sir R. Awdry proposed the health of the chairman, and bore witness to the sympathy between capital and labour evidenced by the arrangements made for the well-being of the employés in the Robertson Lamp Works, at Hammersmith. The toast was received with musical honours.

The after proceedings included a musical programme, and a Pierrot entertainment by "The Follies," under the direction of Mr. H. G. Pélissier, concluding an exceedingly pleasant and enjoyable evening.

Electric Lighting at the Crystal Palace Automobile Show, 1904.—The electric lighting of the Automobile Show, 1904, just closed, was carried out by the Electric Lighting Boards, Ltd., of 80, York Road, King's Cross. Over 10,000 8-C.P. lamps were installed by the company on upwards of 150 of the exhibitors' stands, in addition to a large number of motors for driving exhibits. The company put down, at short notice, a complete electric lighting plant in the Palace grounds, including the necessary building for the power station. The plant included one Marshall 80-H.P. portable engine, driving by belt a Crompton 250-amp., 220-volt dynamo; one 35-H.P. vertical open type engine, driving a Crompton generator by belt; two compound, open type, vertical engines, direct coupled to Messrs. Johnson & Phillips' 35-KW. generators; and two simple engines, direct coupled to dynamos as above. There were also three 40-H.P. gas engines, driving generators by belt. Three loco-type boilers supplied steam through flexible steam piping. Cables were taken from the generators to a main switchboard fixed in the Egyptian Court, and made by Messrs. Nalder Bros. & Thompson, Ltd., of London. It consisted of nine dynamo panels, and distribution panels consisting of 13 100-ampere ways, each protected by double-pole switch and fuses, with ammeter in circuit with each. All nine generators were run in parallel, and little difficulty in regulation was experienced. From the distribution panels 13 100-ampere cables were taken to distribution points under the floor of the Palace. From each distribution point cables were taken to the various stands, the looping system being adopted in the case of the smaller stands. The whole of the distribution cables were of the E.L.B. type, and every stand in the show was wired on the E.L.B. system.

Among the principal stands may be mentioned the following:—Messrs. Panhard & Levassor, 700 lights; London Motor Garage, 400 lights; Palmer Tyre Co., 400 lights; Ariel Motor Co., 350 lights; Milnes Daimler, 350 lights; Wolseley, 200 lights; Jarret & Letts, 300 lights; Oldsmobile Co., 200 lights.

The plant and apparatus was practically erected three weeks before the opening of the Show, while owing to the backwardness of the stand-holders in completing their stands, the whole of the wiring was practically done during the three days prior to the opening of the Show. The work was carried out by the E.L.B. staff, and a large temporary staff. It was generally stated that the electric illuminations of this Show surpassed anything seen at a similar show in this country. We might mention that the Paris Automobile Show, and the New York Automobile Show were lit on the E.L.B. system. It is also being used at the St. Louis Exhibition, 1904.

Personal.—Mr. G. Hughes, manager at the Horwich works of the L. and Y. Railway, has been appointed chief mechanical engineer at the works, in succession to Mr. Hoy, who has become general manager to Messrs. Beyer, Peacock & Co., Manchester. Mr. Oliver Winder, who has been manager at the Newton Heath carriage works, succeeds to the position vacated by Mr. Hughes. Mr. H. N. Greely follows Mr. Winder as chief at the carriage works, with Mr. C. H. Montgomery as assistant.

Mr. H. M. Harris, of Messrs. Harris, Lee & Co., electrical engineers, of Johannesburg and Cape Town, is expected to arrive in London (Carron House, 14, Upper Thames Street, E.C.) at the end of this month.

Preston T.C. has appointed Mr. Chas. Thompson, of Manchester, as permanent way inspector for the tramways.

South African Notes.—*Pietermaritzburg.*—The T.C. has recently invited applications for the position of tramways manager at a salary of £400 per annum, for its new tramway scheme.

Durban.—Mr. J. Roberts, the borough electrical engineer, has left for England on six months' leave. His London address will be c/o Webster, Steel & Co., 5, East India Avenue, E.C.

Lorenço Marques.—The new electric trams, which have been installed at Lorenço Marques by the Delagoa Bay Development Corporation, Ltd., began running on February 17th. The system was formally opened by the Governor. The lines are to be extended to the suburbs at an early date.

Royal Society.—The following papers were down for reading on February 25th:—"Electromotive Phenomena in Mammalian Non-Medullated Nerve," by Dr. N. H. Alcock (communicated by Dr. A. D. Waller, F.R.S.); "On Mechanical and Electrical Response in Plants," by Prof. J. C. Bose (communicated by Prof. S. H. Vines, F.R.S.)

Cars for Sale.—The Southend Council wants offers for two single-deck cars. See our "Official Notices" to-day.

National Electrical Manufacturers' Association.—This Association is to hold its annual meeting at the Hotel Cecil on Tuesday next, March 1st, to receive the annual report and balance-sheet, also to elect members of committee, and an auditor.

THE CENTRAL STATION ENGINEER.

DONCASTER T.C. has appointed Mr. E. S. RAYNER, of Swansea, as electrical engineer and tramways manager.

The recommendation of the Monmouth Committee, to which we referred last week, was that Mr. BLAKE, the electrical engineer, should also take the post of borough surveyor, *not* inspector of nuisances. Mr. Blake has no desire for the addition of special duties under this head—at any rate not beyond those with which every central station engineer has to concern himself. The end of the matter was correctly stated in our last issue.

Mr. R. W. KEMBLE, of Bournemouth, has been appointed assistant-in-charge at West Ham, and Mr. T. C. HUNT, mains assistant to the electrical department.

The salary of Mr. M. B. HENRY, chief assistant to the Nelson Corporation Electricity and Tramways Department, has been increased to £130 per annum, on the recommendation of Mr. W. ALAN FRASER, chief electrical engineer and tramways manager.

The annual dinner of the Croydon Electricity Works staff took place on Friday last, 19th inst. Mr. Ald. MILLER presided, supported by Mr. Coun. ROGERS, Mr. J. GRAY SCOTT (chief engineer), Mr. ALEX. C. CRAMB (chief assistant engineer) and many other gentlemen. A capital programme of music was carried out by the members of the staff and friends, and the opportunity was taken of presenting to Mr. J. GRAY SCOTT (who is shortly leaving for Hong Kong) an illuminated address from the works staff.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

International Electric Traction and Power Co., Ltd. (65,949).—This company's annual return was filed on January 25th, when 179 shares had been taken up out of a nominal capital of £25,000 in 2,500 shares of £10 each. £7 10s. has been called up on each share, and £1,335 has been received (including cash paid in advance of calls), leaving £132 10s. in arrears. No mortgages or charges.

Aberystwyth and Chiswick Electricity Supply Corporation, Ltd. (38,854).—Issue, on January 20th, of £4,000 4½ per cent. debentures, part of series created by resolutions of November 2nd, 1900, and March 8th, 1901, to secure £50,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series: £28,000.

Auckland Electric Tramways Co., Ltd. (61,199).—Three mortgages, dated January 25th, 1904 (executed in pursuance of obligations under a trust deed of July 14th, 1904, securing £285,100 debenture stock, with power to increase to the amount of the subscribed capital), have been registered. Property charged: (By first and second mortgages): Certain lands and premises in Auckland, N.Z., and its suburbs. (By third mortgage): Certain tramway concessions for places in the suburbs of Auckland, and premises. Trustees: Electric and General Investment Co., Ltd., 1 and 2, Great Winchester Street, E.C.

PARLIAMENTARY.

Standing Order Proofs.—Standing Orders have been complied with in the case of the following Bills:—Govan Burgh (Electricity), and Mid-Cheshire Tramways; Charing Cross, Euston and Hampstead Railway; Baker Street and Waterloo Railway; North Staffordshire Railway; and Southport and Lytham Tramroad (extension of time); the Preston and Lytham Tramways and Tramroad Bill, and the Watford and District Tramways (Extension of Time).

Glasgow Corporation (Tramways).—In the case of this Bill it has been found that Standing Orders have not been complied with, and the Bill will have to go before the Standing Orders Committee.

London County Council (Tramways).—The Standing Orders Committee of the House of Commons have reported that the above Bill may be allowed to proceed, provided that Tramways Nos. 6, 8, 8A. 8B, and 8C, be struck out. No. 6 is a line 3 miles 5 furlongs in length, from Shootup Hill, Hendon, to the Marble Arch. The other lines struck out were to affect Streatham.

Rotherham Corporation Bill.—The Standing Orders Committee of the House of Commons has reported that the above Bill may proceed subject to the power to construct tramways 5 and 6 being struck out of the Bill, and that No. 4 be also struck out, unless the consent of the local and road authorities be proved before the Committee. Tramway 5, which is 1 mile 2 furlongs in length, concerns the parish of Whiston, and No. 6 is a small connecting link. Tramway 4 is also situated in Whiston, and is about 2 furlongs in length.

Cheshire Electricity and Power Gas.—The Weaver Navigation Trustees have withdrawn their opposition to this Bill.

Electric Power Bills.—The East London and Lower Thames Electric Power, the Lincolnshire and Yorkshire Electric Power, the Cheshire Electricity and Power Gas, and the North-Western Electricity and Power Gas Bills have been formed into a group to be considered by a Committee.

The following petitions have been presented in the House of Commons against the Belfast and North-East Ireland Electricity and Power Gas, by Belfast Harbour Commissioners, the Newry Port and Harbour Trustees, the Great Northern Railway Co. of Ireland, the Belfast and County Down Railway Co., and the Irish Society; the Belfast Corporation Tramways, by the Great Northern Railway Co. of Ireland and the Belfast and County Down Railway Co.; the Bristol Tramways (Extensions), by the Midland Railway Co. and others; the Chesterfield Corporation (Tramways and Improvements), by the Midland Railway Co. and the Derbyshire C.C.; the Clyde Valley Electrical Power, by the County Councils of Renfrew and Lanarkshire; the Holywood Tramways, by the Belfast Corporation and the Belfast and County Down Railway Co.; the Isle of Thanet Light Railways, by the Trustees of the Judith Lady Montefiore College; the Lothians Electric Power, by the Pioneer Electric Co., Ltd., the North British Railway, the Edinburgh and Leith Corporations' Gas Commissioners, the Caledonian Railway Co., the Midlothian and Lanarkshire C.Cs. and others; Manchester Corporation Tramways, by the Stretford and Sale U.D.Cs. and the London and North-Western and the Manchester, South Junction and Altrincham Railway Cos.; Newcastle-upon-Tyne Corporation, by the Durham C.C., the Newcastle-upon-Tyne Electric Supply Co., the Tyneside Tramways and Tramroads Co. and the Tyne Improvement Commissioners; North Wales Electric Power, by the Flintshire C.C. and the Llandudno U.D.C.; the Nuneaton and Chilvers Coton U.D.C., by the Midland and London and North-Western Railway Cos.; the Portmadoc, Beddgelert and South Snowdon Railway, by the Carnarvon Harbour Trustees and others; the Preston and Blackburn Tramways, by the Lancashire and Yorkshire Railway Co.; the Preston and Lytham Tramways and Tramroad, by the Lancashire and Cheshire Coal Association and the Mining Association of Great Britain; the Stretford U.D.C., by the Stretford Gas Co., the Trafford Power and Light Supply (1902), Ltd., the British Westinghouse Co., the West Manchester Light Railways Co. and others; the Ulster Electric Power Bill, by the Great Northern Railway Co. of Ireland, the Irish Society, Belfast Harbour Commissioners, the Belfast Corporation and others; and the West Riding Tramways, by the Midland and the Lancashire and Yorkshire Railways Cos., the West Yorkshire Coal Owners' Association, the Castleford U.D.C. and others.

Saturday was the last day for the presentation of petitions in opposition to private Bills in the House of Lords. The following are the names of some of the objectors whose notices have been deposited:—To the Preston, Chorley and Horwich Tramways, the Lancashire C.C., the Liverpool Corporation, and the L. and Y. Railway Co.; to the Belfast and North-East Ireland Electricity and Power Gas, by the Antrim C.C.; to the Belfast Corporation Tramways, by the Belfast Street Tramways Co.; to the Bristol Tramways Extension, by the Bristol Corporation and other bodies; to the Chesterfield Corporation Tramways, by the Derby and Notts Electric Power Co.; to the Derby and Notts Electric Power, by the Newark Corporation; to the Great Yarmouth Corporation, by the Great Yarmouth Port and Haven Commissions; to the Ilford U.D.C., by the East London Waterworks Co. and three others; to the Isle of Thanet Light Railway, by the Ramsgate Corporation and another; to the Manchester Corporation Tramways, by the Great Northern Railway, Lancashire and Yorkshire Railway, Great Central Railway, Salford Corporation and three others; to the Metropolitan District Railway, by the L.C.C., City Corporation, Fulham B.C. and the Grand Junction Water Co.; to the Metropolitan Railway, by the L.C.C., City Corporation and the Metropolitan Electric Supply Co.; to the Mid-Cheshire Tramways Co., by the Macclesfield Committee, Manchester Corporation, &c.; to the North Wales Electric Power, by the Anglesea C.C. and many others; to the Preston and Blackburn Tramways, by the Leicestershire and Cheshire Coal Association and others; to the Preston and Lytham Tramways, by the Southport and Lytham Tramway Co. and the Lancashire and Yorkshire Railway; to the Southport and Lytham Tramways, by the Blackburn, St. Anne's and Lytham Tramways Co., the promoters of the Preston and Lytham Tramways Bill, the Lancashire and Yorkshire and London and North-Western Railway Cos.; to the Tyneside Tramways and Tramroads, by the Newcastle-upon-Tyne Corporation; to the Ulster Electric Power, by the Londonderry Corporation, Antrim C.C. and another; and to the West Riding Tramways, by the Yorkshire Electric Power Co., Wakefield Corporation, Great Northern Railway and three others.

Electric Lighting (London) Bill.—This Bill which is promoted by the Board of Trade to provide for the alteration and readjustment of the area of supply of electricity within the administrative County of London, so as to make the boundaries of these areas coterminus as far as may be with the areas of local government fixed by the London Government Act, 1899, came before the Examiner of Standing Orders on Monday, and it was found that the requirements of the House had been complied with.

Opposition Withdrawn.—The South Metropolitan Gas Co. has withdrawn its opposition to the North and South Woolwich Electric Railway; and the Regent Dock and Canal Co., to the St. Marylebone Electric Lighting.

London United Tramways.—The Standing Orders Committee of the House of Commons have recommended in the case of the London United Tramways Bill that the parties be permitted to proceed with their Bill provided that the powers to construct tramways Nos. 1, 1A, 1B, 1C, 1D, 1E, 4, 5 and 5A, be struck out of the Bill. This decision knocks out of the Bill the proposed tramways in Brentford, Old Brentford and Slough. The tramways left in the Bill are situated in the parishes of East Bedfont, Feltham, Stanwell, Ashford and Staines.

London United Tramways (Railway) Bill.—The Standing Orders Committee of the House of Commons have decided that Standing Orders shall not be dispensed with in the case of this Bill, and accordingly it drops this session.

ELECTRICITY SUPPLY ACCOUNTS.

Portsmouth Municipal Electrical Supply.

The returns of the Portsmouth electricity department for the period ending March, 1903, are in some respects disappointing, the works costs (including public lighting) having advanced to 2·56d. per unit, a figure considerably higher than that of the previous year, when an extraordinary amount was included for new workshop construction. With all this, it is satisfactory to note the steady progress in output, and the fact that after meeting financial charges amounting to over £11,000, a balance of £3,000 remained, which was transferred to the reserve fund account, the latter now amounting to £7,725.

The prices charged are—For private lighting, 4½d. and 4d. per B.T.U.; power and heat, 1½d. per unit; public lighting, arcs, £18, and incandescents, £3 5s. per annum. The borough electrical engineer is Mr. W. S. Foale.

General Statement.

For year ending March 31st—	1903.	1902.
Total capital expended	£218,446	£202,062
Number of units sold—		
Private supply	1,549,431	1,408,414
Public lighting	439,876	439,376
Total number of units sold	1,989,307	1,847,790
Equivalent No. of 8-c.p. lamps connected	120,780	106,566
Number of public lamps	264 arc	264 arc
	107 inc.	106 inc.
Maximum load in kw.	1,862	1,713
Revenue account—		
Gross revenue	£35,282	£32,209
„ expenditure	£21,203	£18,954
„ profit	£14,079	£13,255
Average price obtained per unit—		
Private lighting	4·36d.	4·25d.
Public lighting	2·79d.	2·75d.

Revenue Account for Year ending March 31st, 1903.

Gross revenue	£35,282	= 4·25d. per unit.
Works and distribution costs (inc. pub. ltg.)	£17,478	= 2·11d. „
Total works costs	£21,203	= 2·56d. „

Profit Statement.

Interest on loans, &c.	£5,003
Sinking fund	6,076
Balance transferred to reserve fund	3,000
Gross profit	£14,079

Blackpool Municipal Electrical Supply.

The year's working at Blackpool exhibits a satisfactory return to the profitable conditions prevailing in 1900. The revenue is considerably up, and working expenses, despite the extended operations, have decreased, both in total and per unit. As a result the gross profit is £3,000 higher than in 1902, and after meeting financial charges, both the reserve fund and general district rate benefit in the surplus. The reserve fund is in a particularly healthy condition, and now amounts to over £20,000.

The prices charged are—For private lighting, 7d. and 2d. per B.T.U. maximum demand system; churches, 5d.; power and heat, 2½d. per unit. Traction, 2d. per unit up to quarter million units, 1½d. after. Mr. Charles Furness is the borough electrical and tramways engineer.

General Statement.

For year ending March 31st—	1903.	1902.
Total capital expended	£177,765	£171,033
Number of units sold—		
Private supply	965,290	924,415
Public lighting	266,376	289,659
Traction	937,797	804,058
Total number of units sold	2,169,463	2,018,132
Equivalent No. of 8-c.p. lamps connected	106,052	100,978
Number of public lamps	263 arc 290 inc.	260 arc 290 inc.
Maximum load in kw.	1,730	1,625
Revenue account—		
Gross revenue	£29,461	£27,911
„ expenditure	£16,862	£18,720
„ profit	£12,599	£9,191
Average price obtained—		
Private lighting	4·14d.	4·10d.
Public lighting	5·04d.	4·93d.
Traction	1·82d.	1·83d.

Revenue Account for Year Ending March 31st, 1903.

Gross revenue	£29,461	= 3·26d. per unit.
Works and distribution costs (inc. pub. ltg.)	£14,673	= 1·62d. „
Total works costs	£16,862	= 1·87d. „

Profit Statement.

Interest and sinking fund	£10,247
Balance to reserve fund	1,410
Balance to general district rate	1,000
Unappropriated balance from 1902	— 58
Gross profit	£12,599

CITY NOTES.

Metropolitan Electric Tramways, Ltd.

The report for 1903 states that the company holds 78,504 out of a total of 110,923 issued shares in the North Metropolitan Tramways Co., which operates by horses 48¼ miles of tramways under lease from the London County Council. The company has also acquired about two-thirds of the issued share capital of the Harrow Road and Paddington Tramways Co., and has entered into an agreement for the purchase of that company's undertaking, consisting of 2¾ miles of tramways, situated in the metropolitan borough of Paddington and the urban district of Willesden. An Act of Parliament obtained last year authorised the conversion of these tramways to electric traction, and a Bill has been deposited to confirm the agreement for sale and to authorise certain street widenings. Conditionally upon these widenings being carried out, the Willesden Urban District Council has agreed not to exercise its rights of purchase under Section 43 of the Tramways Act, 1870, until June 25th, 1930. The County Councils of Middlesex and Hertfordshire have entered into agreements to construct and to lease to the company about 49¼ miles of light railways, of which 37½ miles have been authorised, and the remainder are awaiting confirmation by the Board of Trade; 11½ miles which are under construction by the County Council of Middlesex, are now being electrically equipped by the company. The company's own tramways, 8½ miles in length, of which 7½ miles are in Middlesex and the remainder in the county of London, are still worked by horses, but the work of reconstruction for electric traction, which was commenced early last year, is nearing completion. It is anticipated that these 20 miles of tramways and light railways will be opened for public traffic by electric traction this summer. The company, as lessee of the Hertfordshire County Council, will be entitled to running powers over the lines authorised by the Watford and District Tramways Act, 1901, and the Watford and District Light Railway Order, 1903, when constructed, and has entered into an agreement with the Walthamstow U.D.C. for mutual running powers. In July last the company acquired by the issue to the British Electric Traction Co., Ltd., of 43,652 ordinary shares of £1 each, fully paid, 1,710 shares of £10 each in the North Metropolitan Electric Power Supply Co., of which 1,460 shares are fully paid and the remainder £2 paid, and also the benefit of a claim for £13,551, recoverable from the Power Supply Co. The company has since subscribed for 1,500 further shares of £10 each in the Power Supply Co., out of the proceeds of which this debt of £13,551 has been liquidated. The Power Supply Co. has rights in perpetuity, under three Acts of Parliament, for the supply of electricity in bulk within an area of about 325 square miles in Middlesex, Hertfordshire and Essex. The authorised share capital is £500,000, divided into 50,000 shares of £10 each; 3,212 shares have been issued, upon which £30,104 has been paid. The company is erecting a main power station at Brimsdown, near Enfield, and has purchased from the Willesden U.D.C. the power station built by that Council. Mains are being laid to connect these power stations with the various sub-stations which are being constructed at suitable points in the area for the purpose of supplying energy for the light railways and tramways and to other consumers in bulk. The company is now supplying electricity in bulk for electric lighting at Hertford and at Willesden, and negotiations are proceeding for agreements to supply other local authorities with electricity in bulk. The directors in June last made an issue of preference shares, and 185,984 shares were subscribed for and paid up in cash. The whole of the authorised 500,000 preference shares have thus been issued, and are quoted in the Official List of the London Stock Exchange. During the past year 99,250 ordinary shares have been issued as fully paid—namely, 37,000 were allotted on June 12th to the British Electric Traction Co., Ltd., in payment of the amount due to them as per the last balance-sheet; 18,598 were allotted to the same company as the agreed commission for underwriting the subscription of the preference shares issued in June; 43,652 were allotted on July 24th to the same company in connection with the purchase of that company's interests in the North Metropolitan Electric Power Supply Co. The issued capital of the company is:—500,000 5 per cent. cumulative preference shares of £1 each, fully paid; 177,789 ordinary shares of £1 each, fully paid; 40,750 ordinary shares of £1 each, 6s. paid; 314,016 deferred shares of £1 each, fully paid. On February 29th, 1903, the outstanding 4 per cent. debentures, amounting to £29,100 were redeemed at par. As part of the purchase price of the 8½ miles of tramways, the company has assumed the obligations, both as to principle and interest, of the £150,000 3½ per cent. debentures of the North Metropolitan Tramways Co., and there is also due to that company £10,000 in cash. £22,160 2½ per cent. Consols have been borrowed from the British Electric Traction Co., Ltd., for deposit with the County Council of Middlesex, to secure the performance by the company of its obligations under the agreement for the lease of light railways. The deposit is to be released upon the grant of the lease by the London County Council. Under the contract for purchase of the Willesden power station, the company has guaranteed the payment by the Power Supply Co. to the Council of the purchase price of £72,034, plus interest, by half-yearly instalments extending over a period of about 24 years, or, at the option of the Council, in one sum without interest, upon the Council giving six months' notice. The company has, as mentioned above, entered into an agreement for the purchase of the undertaking of the Harrow Road and Paddington Tramways Co. at a price to be agreed, or, failing agreement, to be determined by arbitration. The company already owns 4,212 of the 6,335 issued shares in that company. Pending the issue of further capital, the directors have obtained a bank advance (amounting at the end of the year to £64,000) to meet the payments due on contracts for the construction and equipment of tramways and light railways, for the erection of the power station at Brimsdown, the laying of cables and the building of car-sheds and sub-stations. In view of the further capital requirements of the company for the works in progress, the directors propose to make an issue at an early date of debenture stock. Gross revenue for 1903 covered by the account amounted to £92,276, including the dividends on shares held in the North Metropolitan Tramways Co. and the Harrow Road and Paddington Tramways Co. Gross traffic receipts from the horse tramways owned by the company amounted to £66,973, notwithstanding the unfavourable weather during the past year, and the dislocation of traffic consequent upon the reconstruction of the lines. After deducting all expenses chargeable to revenue, interest on the £150,000 3½ per cent. debentures of the North Metropolitan Tramways Co. and on the bank advance, and writing off £1,319, there remains a net profit of £22,198. The dividend of 5 per cent. on the cumulative preference shares for the year absorbs £20,350, leaving a balance of £1,848, which is repayable to the British Electric Traction Co., Ltd., in reduction of the amount of £5,276 12s. provided by them in January, 1903, under their guarantee of the preference dividend.

The meeting was held on Wednesday, at Salisbury House, E.C., Mr. Emile Garcke presiding.

In moving the adoption of the report, the Chairman said that he would give a brief summary of the essential features of the company's enterprise. He dealt with them under five heads. First there were the company's own tramways, of which they had 8½ miles, 1 mile being within the London County area. The tenure of 7½ miles was until 1925 and 1930 and that of the 1 mile

until 1910. The tramways were purchased from the North Metropolitan Tramways Co. last year. The price paid for the 7½ miles was £200,000. They had now purchased the mile of line within the London area for the sum of £10,000. The purchase had been made with the approval of the Board of Trade. At the present time the tramways were being re-constructed for electric traction, 6 miles having already been completed, and it was hoped they would be open for electric traction before the summer. With regard to the one mile within the London County area, the L.C.C. had taken proceedings against the company for having commenced the reconstruction of that portion, but as the matter was *sub judice*, he would not refer further to it, except to say that the action of the L.C.C. resembled somewhat that of the dog in the manger. The second matter to which he had to refer was the North Metropolitan Tramways. They held the majority of the shares in that company, £78,000 out of £110,000. The company operated 48¼ miles of tramways by horse traction under lease from the L.C.C. until 1910. At present nothing had been done with regard to reconstruction. The third matter was the Harrow Road and Paddington undertaking. The number of miles open was 2¾, worked by horse traction. Last year the company obtained an Act of Parliament authorising the conversion of the line to electric traction, and this included the lines within the London County area. A Bill had also been deposited to confirm the agreement for the sale to that company of the undertaking, and to authorise certain street widenings. The next item to which he wished to draw attention was the agreements which had been entered into by the County Councils of Middlesex and Hertfordshire to construct and lease to the company some 50 miles of tramways; 37½ miles had been sanctioned, and the remainder was awaiting sanction. The County Council of Middlesex were constructing 11½ miles, and the company was equipping that portion electrically. Some nine miles had been completed. It was hoped that something like 20 miles of tramways and light railways worked on the overhead system would be in use by the summer. The last matter was that of the company's power stations. The company was building a power station at Brimsdown, near Enfield, and there had been an arrangement made with the Willesden U.D.C. for the transference of their new power station to the company. It was considered necessary that the company should have two power stations, one in the East and another in the West. With regard to the Willesden station, it was rather larger than was required for local purposes, but the company would be able to work the station economically and he thought that the U.D.C. would be able to obtain energy cheaper from them than they would be able to generate it themselves. The company had agreed to pay £72,034 for the station, the amount to be payable half-yearly; though, at six months' notice, the Council could demand to be paid the whole amount, and in that case, of course, no interest, other than that which had accrued, would be paid. Arrangements had been made with several local authorities for them to take a supply of energy for distribution. It would be cheaper for a local authority to purchase its energy than for it to put up a small station of its own. In conclusion, he said that he considered that the affairs of the company were satisfactory in every way, and he believed they would continue to be so.

In answer to a question but by a shareholder, the solicitor to the company said that the proceedings taken by the L.C.C. were to obtain an injunction restraining the company from in any way reconstructing that mile of tramway for electric traction until the expiry of the lease. It had no particular reference to the overhead system.

Sir Ernest Spencer, M.P., seconded the motion, which was carried.

Further business included the re-election of Mr. E. Garcke and Mr. W. L. Madgen as directors and the re-election of the auditors, Messrs. Price, Waterhouse & Co., at an increased remuneration.

Kensington and Knightsbridge Electric Lighting Co.

The meeting was held on Thursday of last week, at 148, Brompton Road, S.W., Lieutenant-Colonel R. E. Crompton, C.B., presiding.

The Chairman, in proposing the adoption of the report, said that at the last meeting, their then chairman, Sir F. Bramwell, had to deplore the loss of two directors who had served the shareholders since the formation of the company. Now they had to mourn the loss of Sir F. Bramwell himself, who had also been a director from the first. His colleagues on the board had done him the honour of selecting him to fill the vacancy thus created, and while he felt that it would be hard to follow in the steps of Sir Frederick, the condition of the company's affairs, both financially and from an engineering point of view, was so good that his task should prove an easy one. Everything relating to the company was in a satisfactory condition, and boded well for its future progress, and to a continuance of satisfactory dividends. Turning to the report, they were able to show a satisfactory increase in the number of lamps supplied. The point to which their renewal fund had reached was satisfactory, and was a feature of great strength, it being now equal to upwards of 15 per cent. of their actual capital expenditure. It was not easy to compare that fund with that of other companies, as the accounts were not kept quite in the same way; but, as far as he could judge, no other company had set aside so large a sum as they had in proportion to its capital expenditure. They were able to declare a dividend of 10 per cent., and in addition a bonus of 2 per cent., making a total distribution for the year of 12 per cent. They had adopted that method of distributing the profits only after very careful consideration. They were aware that from time to time as they had reduced their cost production, they had given back part of it to their customers in the shape of reduced prices, but it was not possible or convenient to give those reductions yearly. They must be made at longer intervals of time, as after each reduction, for some little time their profits were somewhat diminished, until the increased consumption, following on the reduced price, came to their aid. Then, in the course of a year or two, the amount carried forward mounted up, until, as in the present case, they considered they should distribute part of it to the shareholders in the form of a bonus. By distributing those surplus profits in the form of a bonus, they felt they were carrying out the policy of maintaining the dividends at as steady a level as possible, and thus avoiding any chance of a set-back during years when fuel was dear. When they looked at the accounts dealing with the working cost, there were points in them which were exceedingly satisfactory, and he thought the shareholders ought to congratulate themselves, and to thank the staff who had produced such excellent results. The total working cost this year had reached the lowest figure ever reached in London, and, as they had been able to produce cheaply, they had been able to sell cheaply. There was one item in the accounts on which he felt quite as strongly as their late chairman; he referred to the iniquitous manner in which they were assessed for rating purposes. At present the assessment was based on the amount of their profits, and, consequently, the more they reduced their working expenses, the greater the sum on which they were assessed. As a consequence, they now paid in the form of rates to the two parishes in which their works were situated, a sum equal to 60 per cent. of their coal bill, whereas the other companies adjoining them only paid two-thirds of the amount. Of course that was a matter over which they had no control whatever, but it was only right that the shareholders should know what a large proportion of their receipts went to the public authorities. In conclusion, he said the directors had decided to notify a considerable reduction in the charge for current under certain conditions of supply.

Mr. R. W. Wallace, K.C., seconded the motion, and the report was adopted.

National Telephone Co.

Sir H. Fowler M.P. (chairman) presided on Thursday last week at Hamilton House, E.C., over the thirty-first ordinary general meeting of the above company.

In moving the adoption of the report, the Chairman said that so far as the half-year was concerned, he hoped the report would be regarded as satisfactory. The income during the half-year amounted to upwards of £941,000, as compared with £868,000 in the corresponding half-year of 1902, or an increase of £72,799. The working expenses amounted to £527,000, as against £473,000, an increase of £54,000. The net result for the half-year, after deducting the Post Office royalties, which amounted to £86,236, was a profit balance of £327,739, as compared with £316,000 for the corresponding period last year, showing an increase of £11,185. The rentals carried forward amounted to £827,000, as against £771,000. There was an available balance for the half-year of £269,421, and the board recommended the payment of the same dividends as were paid for the last half-year:—6 per cent. per annum on the first and second preference shares; 5 per cent. on the third preference shares; 6 per cent. on the preferred stock and 5 per cent. on the deferred stock. It was proposed to transfer £110,000 to the reserve fund and to carry forward the balance of £10,505. Dealing with the figures for the whole year, he said that the gross income of the company in 1902 was £1,691,000, and for 1903 £1,835,000, which showed an increase on the whole year of £144,000. After deducting P.O. royalties, the net income exhibited an increase of £130,000. The working expenses had increased by some £85,000. The net result of the year was an increased profit of £44,897. In 1902 they carried to the reserve fund £175,000, and this year they proposed to carry to that fund £195,000, an increase of £20,000. As to the capital expenditure, in 1902 they expended £562,000, and in 1903 £747,000, or an increase of £185,000 for the latter year. Rent, rates and insurance had increased by £10,150 during the 12 months. In 1902 they spent £291,000 on maintenance and renewals, and in 1903 £337,000, an increase of £46,649. The heavy increase in their insurance premiums was due to their having had one or two disastrous fires, and the insurance companies had come to the conclusion that they must raise the rates. Turning to general matters, he wished to call attention to their unexecuted orders. Complaints were constantly made to the effect that an order given to the telephone company was not executed for some time. Now, there were two reasons why they did not execute their orders as expeditiously as a request for a pound of sugar or a ton of iron. First, there was no new order which did not mean the expenditure of additional capital, and then there were great difficulties with regard to wayleaves. They might rely on it, however, that the company did its best in each case. To show them the increasing demand on the company for its service, he might state that when he addressed them at that time last year, the number of unexecuted orders amounted to 8,815, and this year they were 10,563. Therefore they would see that their business was not dwindling. The increase was well spread. In London there were 3,324 people waiting, and 7,239 in the provinces. With regard to London, no doubt they were aware that the company was working in partnership, and most harmoniously, with the Post Office. The Post Office were increasing their business, and it had in no way affected that of the company, in fact, the increase in the Post Office business had been accompanied by a very large increase in that of the company. In London their exchange stations in 1901, before the competition of the Post Office commenced, were 39,156, and at the end of 1902, when the competition was fully developed, they were 47,053. At the end of last year they numbered 54,752. That was a figure well worthy of consideration, not only by the shareholders, but by the public. The steady increase

in the number of subscribers, both in London and the provinces, raised a question which for many months had engrossed the attention of the board. If their telephone business was to be carried on efficiently and successfully, it was impossible to discontinue fresh capital expenditure. As he had just said, every new subscriber meant an additional outlay of capital; the difficulty of the board was not to obtain new subscribers, but the lamentable alternative of discouraging that increase as far as possible. He was bound to say that that was a policy under which the board was smarting at the present time, it was the inability to do what they were called upon to perform. The business of a telephone company was naturally progressive, and the board were of opinion that any attempt to retard the progress would, in the long run, be detrimental alike to the value of the company's property, and also a source of great inconvenience to the public, especially in London. For a long time the board had had under consideration what was the wisest course to adopt in the interests of the shareholders. One thing was clear, if London was to be supplied with anything like an adequate telephone service, both the P.O. and the company must face additional expenditure; and the same principle applied to their business in other towns. In connection with the development of their service, the general manager and the chief engineer went to America at Christmas to see what was going on there, not only as to the development of the telephone system, but also as to the latest inventions and the general policy adopted on that side of the water. Mr. Gaine had prepared a memorandum which he (the chairman) would read. Mr. Gaine wrote: "The telephone area of London covered 640 square miles, and had a population of 6½ millions. Greater New York (which included New York City, Brooklyn, Jersey City, Newark and Long Island) had an area of 400 square miles, and a population of four millions. In London the company had some 65,000 and the P.O. 15,000, the total being 80,000. In Greater New York the number was 200,000. In Manhattan Island alone, which had an area of about 21 square miles, there were upwards of 110,000 lines at work. The charges in New York were about three times more than those of London, but notwithstanding that the service was popular. The lowest charge for service in New York proper was £15 12s. 6d. per annum to cover 600 local calls; calls to Brooklyn, &c., varying from 7½d. to 1s. per call. The scale went up to £47 10s. per annum to cover 4,500 local calls." After making similar comparisons with Liverpool, Philadelphia, Edinburgh, and Washington, &c., Mr. Gaine continued: "The charges in these American areas are, generally speaking, about three times as much as those of this company. In the British Town the company gives unlimited service for £10 per annum." The capital invested in the telephone enterprise in America was about £48,000,000. Acting upon the advice of its technical officers, the company during the last few years, arrived at the conclusion that the common battery or central energy system of working was that which was ultimately going to survive. The P.O. had adopted that plan for its London system. Having dealt with the progress made during the past nine years, the chairman contrasted the messages of the company with the telegraphic messages of the Post Office. For the year ending March, 1903, the telegrams numbered 84,570,000, and the messages of the company 939,000,000, the average charge made for the latter being under a halfpenny.

Mr. G. Franklin seconded the motion, and the report was adopted.

Newcastle-on-Tyne Electric Supply Co.

The directors of this company have just issued their report and balance sheet, which shows that during the year ending December 31st, 1903, the total units sold numbered 9,033,625, which, compared with the previous year, is an increase of 3,496,125. The year's profit, including the balance brought forward from last year, is £41,826 18s. 4d., out of which there has been paid interest on debentures and loans £14,031 12s. 9d., and interim dividends, paid in August last, at 2½ per cent. on the amount called up on the preference shares, and 4 per cent. on the amount called up on ordinary shares £11,038 0s. 1d., leaving a balance now to be dealt with of £16,757 5s. 6d., which the directors recommended to be dealt with as follows: in payment of a further dividend of 2½ per cent. on the amount called up on preference shares, and 4 per cent. on the amount called up on ordinary shares, making respectively 5 and 8 per cent., leaving a balance to be carried forward of £1,099 0s. 8d. The expenditure on capital account has been increased during the year by £357,256, which included the purchase of the assets of the electricity undertaking of the Walker and Wallsend Union Gas Co., and the outlay on the new generating station at Carville, as well as the ordinary extensions to the company's system.

Crossley Bros.

The report for 1903 states that the amount at the disposal of the directors is £118,681, out of which a dividend has been paid on the preference shares at the rate of 5 per cent. per annum, and on the ordinary shares at the rate of 10 per cent. per annum, leaving £80,081. It is proposed to pay a further dividend for the second half of the year at the rate of 5 per cent. per annum on the preference shares, and 12 per cent. per annum on the ordinary shares (making 11 per cent. for the year), leaving £35,777. As this balance is unusually large, and a shrinkage in the value of investments has been taking place for some years, which amounts now to £17,000 on the £130,000 invested, the directors recommend that the invested funds be written down by this amount, and that £18,777 be carried forward.

Bristol Tramways and Carriage Co.

The annual meeting was held on February 17th. Mr. George White, the chairman, pointed out that the receipts from the tramway department had increased from £197,133 last year to £211,904 this year, which was equivalent to 7½ per cent., although the system was the same as before as far as mileage was concerned. This more than bore out his anticipation that they might fairly look for an average yearly increase of 5 per cent. per annum. After alluding to the carriage department, Mr. White said the net profit of the company was £88,387 against £82,017. They were bringing their reserve fund from £112,133 to £127,458, and he drew attention to the fact that this reserve was invested in high-class securities, and it had been decided that the value of that fund should be taken at the medium market price of those investments on the day the account was made up. The sum left for appropriation among ordinary shareholders enabled a final dividend at the rate of 9½ per cent. to be paid. After the adoption of the report, and of other formal resolutions, the chairman explained the company's extensions, for which a Bill was now being promoted in Parliament. These extensions covered about eleven miles of road, and were, for the most part, outside the city of Bristol. Both the Gloucester and Somerset County Councils had met the company in a fair spirit and accepted the clause providing that the option of purchase should not arise until 42 years from the date of the passing of the Act, and that if they did buy, they must do so at fair market value, as a going concern. With some of the district authorities some differences had arisen, and the Long Ashton populace seemed to feel that an electric tramway would be a burden to their very existence, therefore, with regard to that 1½ miles of line, they did not propose to further trouble the highly-strung nervous population of that sylvan retreat. Some of these questions with district authorities, and with the Bristol Corporation, were still the subject of negotiation.

Oxford Electric Co., Ltd.

The directors' report for 1903, to be submitted at the meeting on Friday, March 4th, says:—

The revenue account shows a profit (including £276 brought forward from last year) of £10,545. After providing £2,041 for debenture and other interest, and writing off £624 on account of hire-purchase installations, the balance available for dividend is £7,831, which the directors propose to appropriate as follows:—In payment of a dividend at the rate of 6½ per cent. per annum on the share capital ranking for dividend (whereof 2½ per cent. was paid in September last), £4,550, and in adding £2,500 to the reserve and renewal of plant account, which will then amount to £7,000; the balance of £831 to be carried forward to next year's account. It is estimated that at December 31st last there was the equivalent of over 55,000 8-c.p. lamps connected to the mains. The number of Board of Trade units sold during 1903 was 12 per cent. larger than in the previous year. The capacity of the generating plant has been increased by 375 kw., and additional sub-stations have been installed at Christ Church, Merton College and New Road. Extensive additions to the mains have been made in Banbury, Woodstock, New, Mansfield and Oakthorpe Roads; also in St. Ebbe's, Brewer, Merton, Becket and New-Inn-Hall Streets.

Hart Accumulator Co.

The directors' report for 1903 shows a profit for the year of £5,860, and the balance brought forward from last year is £4,877, amounting together to £10,737. A dividend of 12½ per cent. per annum on the ordinary shares is recommended, absorbing £5,000, leaving £5,737 to be carried forward. The buildings, plant, tools, &c., have been augmented by £1,790, which has been charged to capital, and due depreciation on same has been made. The maintenance of the works, plant, &c., has been well kept up at a cost of £724, which has been paid for out of revenue.

Last year (1902) the dividend was 15 per cent., but the carry forward was £860 less. A resolution is to come before the meeting on March 2nd to increase the capital from £40,000 to £60,000 by an issue of 6 per cent. cumulative preference shares, but it is not stated for what purpose the money is needed.

Brockie-Pell Arc Lamp, Ltd.

Sir Dixon Hartland, M.P., presided at the meeting of this company held at Worship Street on Friday last. He moved the adoption of the following report:—

In submitting herewith the profit and loss account and balance-sheet for the period ending December 31st, 1903, the directors regret that the result of the 18 months' trading has not been more satisfactory. After writing off the sum of £632 6s. 2d. for depreciation on tools and patterns, there remains a debit balance of £64 16s. 5d. to be carried forward. The present depression of trade, and the consequent extremely keen competition both of English and foreign arc lamp manufacturers, have caused a reduced turnover and smaller manufacturing profits. The directors have used every means to meet the requirements of the arc lamp trade, and the lamps which are now being manufactured by the company, both of the open and enclosed patterns, are of the most improved types. During the period under review the company has received large (extension) orders for its lamps for the lighting of St. Pancras and Partick, besides orders for Glasgow, Shoreditch, Southend, Leeds, Stretford and West Ham. In accordance with the articles of association, Sir F. D. Dixon-Hartland retires, and, in consequence of the pressure of Parliamentary work, does not seek re-election. The directors propose that this vacancy be filled by a gentleman who has an intimate knowledge of the trade, and who will devote his entire time as managing director.

He said that Lord Suffield, the chairman, under doctor's orders, was unable to be present. He was sorry that the report was not so satisfactory as on the last occasion, but they were not alone, as many of their competitors were in the same position. The Westinghouse Co. had never paid a dividend upon its shares, and now Crompton & Co., Royce & Co., and others that he need not go into had passed their interim dividends on even the preference shares. The cause of the Brockie-Pell failure to make any dividend was lack of work. The trade returns showed very con-

siderable falling off through no fault of their own. Fiscal policy had been under discussion, and he drew attention to the position of the arc lamp trade in this connection. Three years ago there were only about three or four competitors for every tender which was issued. Now there were never less than 18 or 20, and in a great number of instances, the tenders sent in were actually less than this company could manufacture at. The speaker went on to show how the foreign manufacturer could sell at a loss abroad, and make a large profit at home because of tariff protections. He could thus keep his works fully occupied, and so manufacture cheaper than otherwise. The British manufacturer had no power to compete against the foreigner. He (the chairman) did not "go" the whole fiscal question, but he was glad it was to be looked into, because he felt that there ought to be a means of retaliation or negotiation with foreign countries to prevent such unfair dumping being continued. If the new arrangement were carried out there would be a difference to all companies over here. In our fiscal position he found an explanation why the work of this company had not been greater in volume. He thoroughly believed when they made their 3 per cent. dividend that they were at the beginning of good days. It had not turned out to be so, but it was not their fault. He thought it was very desirable that they should have a managing director appointed who would give up his whole time to the company and really be responsible for the manufacture and commercial working. They had names of several men before them, and they hoped to be able to select one of these. After stating the holdings of directors to show that they had a real interest in the business, he formally moved the adoption of the report.

This was seconded by Mr. H. W. Maynard, who, referring to the presence of press representatives, suggested that shareholders should blame the board rather than the lamp or its manufacture, as negotiations were proceeding between the chairman and very important persons with a view to amalgamation, and anything said might be detrimental to the negotiations.

A long discussion then ensued, the failure of the directors to bring about success, the large stocks held, the heavy expenditure incurred in keeping up too extensive premises at Worship Street and other matters were referred to, and suggestions were made that some of the directors should make way for business men who knew something about electrical commercial work, also that the company should give up the manufacturing of the lamp to someone else and merely sell it.

Eventually the report was adopted, and a resolution was passed to appoint a committee of inquiry to confer with the directors respecting the business, the names to be fixed at the next board meeting, to which shareholders holding 500 shares and over are to be invited.

Dublin and Lucan Electric Railway Co.

The half-yearly general meeting of the proprietors of this company was held at Dublin on the 18th inst.

The Chairman stated that the increased receipts during the half-year from passengers amounted to £184, and from goods £28. Expenditure had increased by £113, of which amount £72 was incurred through damaged caused by a severe gale in February last. During the period a saving of £80 had been effected through the introduction of condensing apparatus at the power station. The net balance for payment of debenture interest was £1,426, and they proposed to pay a dividend at the rate of 5 per cent. on the preference shares, absorbing £475, and to place £700 to reserve, the remainder to be carried forward.

National Gas Engine Co.

The fourth annual meeting of this company was held at Ashton-under-Lyne. The report to December 31st last shows a net profit of £28,021. The interim dividend of 5½ per cent. per annum on the preference shares paid in July, 1903, amounted to £9,695 and £903 had been appropriated for writing down Consols, leaving a balance of £17,424, which with £8,678 brought forward from last year, left a total of £26,102 to be dealt with. A final dividend of 5½ per cent. per annum on the preference shares and 15 per cent. per annum on the ordinary shares for the six months ending December, 1903, was proposed. Out of the balance £10,000 was proposed for reserve, bringing the latter up to £35,000, and £6,322 was carried forward. The company appears to be in a flourishing condition, and large extensions of works are in hand.

Telegraph Construction and Maintenance Co.

The report for 1903, to be submitted at the meeting on the 1st prox., states that the accounts show a net profit of £108,738 after charging interest on debentures. To this must be added £101,385 brought forward from last year, making a total of £210,123. From this is deducted an interim dividend of 5 per cent., leaving £187,713 to be dealt with. The directors propose to distribute a dividend of £1 4s. per share, together with a bonus of 12s. per share, absorbing £67,230, being at the rate of 15 per cent., and making a total dividend and bonus for the year of £2 8s. per share, or 20 per cent., leaving £120,483 to be carried forward. The shareholders will be asked to approve a form of trust deed constituting a pension fund for the benefit of the staff and their dependents, and to sanction the payment to the trustees to be appointed under that deed the sum of £67,085 appearing in the balance-sheet as set apart for that purpose.

London United Tramways (1901), Ltd.

Mr. Samuel White presided at the annual meeting held at Chiswick on Monday. In moving the adoption of the report (given in our last issue), he said that Mr. Yerkes, the chairman, was absent through illness. The traffic during the year had increased to £280,241, but their expenses had increased to £176,000, the net revenue being £103,850. After paying debenture and preference interest, and an interim 8 per cent. on the ordinary, they were able to pay a final dividend on the ordinary at the same rate. Under the special circumstances, affecting their business during the year, it was an exceedingly satisfactory result. They had made special arrangements for handling very large traffic last summer, but the unpropitious weather interfered. Had the weather conditions been merely normal, they could, without any additional expenditure whatever, have earned from £20,000 to £30,000 more profit. In that case they would have been able to do as they had hoped—form a reserve fund, but that would have to wait; they would not be justified in interfering with the normal dividend of 8 per cent. for the sake of establishing such a fund this year, especially as the undertaking had only just been established, and had a long and successful future before it. The Act obtained last year, although not of very great importance in itself, would effect the conversion to double track of a number of inconvenient short lengths of single line, and the object of the Act was to acquire, by compulsion, a number of properties on the existing route of their authorised tramways. He then referred to the construction of a line now approaching completion, across the Uxbridge Road at the Askew Arms by way of Goldhawk Road and Paddenswick Road to Hammersmith Broadway. That line was only a mile in extent, but it would have a very far-reaching effect and bearing on the undertaking, and especially in association with their neighbouring company, the District Railway. The general outlook of the undertaking was exceedingly satisfactory.

Mr. C. A. Spofford seconded the adoption of the report, and the payment of 8 per cent. dividend, and it was carried unanimously.

The retiring directors and auditors having been re-elected, an extraordinary general meeting was held, at which the solicitor read the heads of the company's Bills relating to tramways and tube railways proposed for the coming session, and after an explanation of them had been given by the chairman, they were approved unanimously.

A vote of thanks closed the meeting.

Imperial Tramways Co.

The annual meeting of this company was held on the 20th inst. at Bristol, Mr. George White presiding.

The Chairman said it had been a somewhat uneventful year; they were benefiting from the position built up by the company, and the satisfactory dividend was the result of that position. With regard to the subsidiary companies, the Corris Railway showed the same dividend of 6 per cent. for 1903 as was paid in 1902, though the traffic receipts were a few hundreds less, owing to the temporary closing of one of the slate quarries on the line through an accident. With regard to the Middlesbrough, Stockton and Thornaby undertaking, the receipts were £49,969, as compared with £49,294 last year. The meeting would be asked to approve of the company's Bill in Parliament to authorise extensions of its system from Middlesbrough to Ormsby, South Bank and Eston, and also for doubling the existing line in that neighbourhood. It had been in contemplation to execute doublings and other facilities in the borough of Middlesbrough, but these had had to be dropped through the attitude of the Corporation.

The report was adopted, and sanction was given to the Bill in Parliament, mentioned by the chairman.

Westminster Electric Supply Corporation.

Lord Suffield presided at the annual meeting held at Eccleston Place on Wednesday, and, in moving the adoption of the report, he congratulated the shareholders on the satisfactory progress of the business, and upon the payment of an increased dividend and the satisfactory carry-forward. The equivalent of 59,153 8-c.p. lamps had been added to the circuits during the year, and applications continued to come in at a satisfactory rate. There had been an increased demand for current for power purposes for passenger lifts, builders' hoists and the charging of motor-car batteries, and the ordinary demand for lighting also continued to grow. The same satisfactory rate of increase had been maintained since the end of the year. The rate charged per unit for energy taken from the Central Co. would in 1904 show a substantial saving over 1903; as the load increased at the station in St. John's Wood the cost would eventually be considerably reduced. In order to meet the growing demand for energy the board had acquired a long lease of a site in Mayfair for an underground station; it was in close proximity to the Davies Street generating station, and it was needed for transforming current received from the Central Co.'s station. That station would be ready in time for next winter's heavy load. Their public lamps in the City of Westminster were 952 arcs and 202 incandescents.

The report was adopted, and the resolution for the dividend on the ordinary shares was carried, also a motion re-electing directors. Votes of thanks closed the meeting.

Notting Hill Electric Lighting Co.

The directors' report for 1903 says that the expenditure on capital account, which at the date of the last balance sheet stood at £210,258, has been increased during the past year by £6,077, of which the principal items are:—£2,126 for new mains; £2,298 for a new 500-H.P. motor-generator erected at Bulmer Place station; £710 incurred in completing the conversion of the leasehold property in Lancaster Road into freehold.

Debentures amounting to £5,000 have been issued to meet the cost of this capital expenditure. The cost of the joint station to date has amounted to £141,778, and joint debenture stock amounting to £135,000 has been issued. This stock is subject to a cumulative sinking fund, which now amounts to £9,223 invested in trustee securities. The following table shows the progress during the past three years:—

1901	82,054 lamps.	Profit	£13,046
1902	99,497 "	"	£14,609
1903	116,360 "	"	£15,018

The number of consumers is now 2,052 and 97 per cent. of these are supplied at 200 volts. The gross revenue shows an increase of £605, and the net profit an increase of £408. The net profit would have been larger by about £5,100 had the charge for current been the same as that for 1902, but the directors were under agreement with the local authority to reduce the charge for current from 6d. to 5d., and the result has been that practically the whole of the profit arising from fresh business has been absorbed. The reduction promises to result in an increase of business, which should augment the net profits in the near future. There has been transferred out of profits to the depreciation, renewal and reserve fund account, the sum of £1,250, and, in addition to this, the sum of £1,031 has been paid over to the trustees of the cumulative sinking fund of the joint debenture stock referred to above. From the net profit remaining is to be deducted the interest on the debentures, amounting to £2,156, the interest on the joint debenture stock, £1,967, leaving £8,607 available for dividend. The directors now recommend the payment of the usual dividend of 6 per cent. on the ordinary shares, which, added to the 6 per cent. on the preference shares already paid, amounts to £8,310, and that the balance be divided, one half being credited to the founders' shares undivided profit account, and the remainder to the other classes of shares. An interim dividend of 3 per cent. on the ordinary shares was paid on July 1st, and the balance of 3 per cent. will be paid forthwith. The directors also recommend a dividend of 5s. per share on the founders' shares. Suggestions have been made with a view to some modification of the capital arrangements which will be more convenient both to the holders of the founders' and the ordinary shares, but will not appreciably alter the respective rights as between the various classes of shareholders, either in the profits or the eventual surplus assets.

The suggestions will be brought forward at the general meeting on Monday, April 11th. The units sold were 1,372,642, but the report does not contain an engineer's statement of electricity generated, used on works, unaccounted for, and so on.

Northampton Electric Light Co.

The annual meeting of this company was held in the Town Hall, Northampton, on the 19th inst. A dividend of 4½ per cent. per annum was declared, and a sum of £209 was carried forward. A sum of £1,200 was written off for depreciation, as compared with £800 last year. Working expenses were reduced, fuel costing 12 per cent. less. The consumers were 704, as against 580 last year, and large extensions in supply are in contemplation.

At an extraordinary meeting following the above, the Chairman moved that the capital of the company be increased to £100,000 by the creation of 50,000 new "B" shares of £1 each, which was adopted.

City of London Electric Lighting Co.—The board has resolved to transfer £45,500 to reserve, and to recommend the following dividends:—On the preference shares, 6s. per share for the half-year ended December 31st, 1903, making, with the interim dividend paid in July, 1903, a total distribution of 12s. per share, or at the full rate of 6 per cent. per annum. On the ordinary shares, 5s. per share, making, with the interim dividend of 5s. per share paid in July, 1903, a total distribution of 10s. per share for the year ended December 31st, 1903, being at the rate of 5 per cent. per annum, and to carry forward about £22,000. Both dividends will be subject to the deduction of income-tax.

Southport and Lytham Tramroad Co.—The ordinary half-yearly meeting took place at Liverpool on Friday last week. Mr. H. A. Watson, who presided, stated that the whole of the capital authorised had been subscribed. Notices to treat had been served on the landowners, and negotiations were in progress with a leading firm of contractors for the construction and equipment of the line, including the conveyer bridge over the Ribble. The report and accounts were adopted.

National Electric Supply Co., Ltd.—The ordinary general meeting of shareholders of this company was held on the 11th inst. at Preston. Dividend of 4 per cent. for the year on preference shares, and 5s. 6d. per share on the ordinary shares for the half-year, making, with the interim dividend paid in July, 8s. 6d. per share for the year, also a dividend of £4 1s. 4d. per share on the founders' shares, were declared.

Official Announcements re Companies.—Unless cause is shown to the contrary, the following are to be struck off the register in three months:—

Railways' Electric Supply Syndicate.
Round's Accumulator Co.
Smokeless Incandescent Furnace Syndicate.

Perth Electric Tramways, Ltd.—The directors are offering £35,000 6 per cent. second debentures to the present holders. The traffic on the system has exceeded all anticipations, and more cars and additional car accommodation are essential in order to cope with the business.

Western Telegraph Co.—Interim dividend 3s. per share (at the rate of 6 per cent. per annum), for the quarter ended December 31st last.

STOCKS AND SHARES.

Wednesday Evening.

Strong suspicion is circulating through the City that the Paris panic of a few days ago was deliberately engineered by certain "financiers" on the Continent, who seized the expected opportunity created by their manœuvres to buy cheaply in all the speculative markets. However this may be (and certainly there are evidences that support the theory), the Stock Exchange and the Bourses have been severely shaken, and the subsequent reaction has failed to wipe out all the losses caused by the slump. Consols are fairly steady, but it is difficult to sell any investment securities at satisfactory prices if the market in them happens to be at all limited.

Central London Railway stocks are weak, the Ordinary having fallen 2 and the Deferred 1, upon sales by some of the French people who took blocks of shares at the commencement of the company's career. We have alluded to this Continental holding on several former occasions, and, with the French investors, stricken with panic, they threw overboard their good stocks along with the bad and mediocre. The last traffic return shows an increase of £164. City and South London is not a bad market at 51½, and Waterloo and City remains at 92½, *cum* the 1½ per cent. dividend to be deducted this week. Metropolitans dipped to 83, but have recovered half a point, Districts keeping steady at 33. No change has occurred in the other electrical railway descriptions. The Great Northern and City reports a take of £950 for its first week's running.

In the traction list, Anglo-Argentine Preference are a shade easier at 4⅞, and City of Buenos Ayres remain about 9, business being done the other day at 8⅞. London United Tramways Debenture has eased off to 103—perhaps upon the absence of provision for a reserve fund, that we noticed last week. The Preference are unaltered at 11½, the rejection of one of the company's Bills, on Standing Orders, being disregarded. British Electric Traction Preference have recovered their fall, being now 11. The Ordinary are better, although not quotably: there are buyers at 10 instead of sellers. British Columbia Electric Preferred has improved to 94½, and the Deferred is 83½. A little business in Calcuttas found the price exactly 6⅞.

Great Northern Telegraph shares are picking up some of their lost strength, and the price is a sovereign better at 23½. Here again it was Continental selling that disturbed the market. The company's line runs, we understand, from St. Petersburg to Vladivostock, and the Post Office authorities have notified that they cannot accept messages by this route. But as the Great Northern has a working arrangement with the Eastern undertakings, the loss cannot be great, and the company, with its convenient land-line, is sure to get a lot of business immediately affairs become more settled. The Eastern group again exhibits an unbroken list as regards fluctuations of price, and the market grumbles with reason at the failure of the public to grasp the good opportunity now presented for a purchase of Eastern stock and "China" shares. Direct United States shares are ¼ down, to 10, while Globe Telegraph and Trust Preferred have advanced ¼ to 12½ middle.

Under the gentle pressure of a few selling orders, Bromptons went back 5s. to 10¼, and Charing Cross Preference are ⅛ lower at 5⅞ upon slight sales of shares by those who want to apply for the new issue. Charing Cross Ordinary had their fall last week, and have not made it up yet; the Preference were then unchanged. Friday, February 26th, is the last day for sending in applications for the new shares. Kensington Debenture has replaced the fall of a point lately shown, although County first Debenture is slightly lower at 107½. Brush Preference are back again to 1¼, and the Ordinary shares have dropped to 15s., but the Debenture stock hardened to 99½. Oxfords at 5⅞ fail to respond to the increase of ¼ per cent. in the dividend. Notting Hills are steady at 13½ upon the declaration of 6 per cent. on the shares once more.

Notwithstanding the declaration of the National Telephone chairman that more money is needed for the extension of the company's business, the Preferred stock has risen to 104, bargains having been done at that price. The other issues keep about the same as before, with not much supply in the market.

Telegraph Constructions continue firm at 34½, upon the issue of an excellent report, but the Miscellaneous section is somewhat neglected. Westinghouse Preference, after being 3⅞, hardened to 4, and the Debenture stock is 94½. Crompton Debentures have fallen a little to 97½. The public is not investing its money to any appreciable extent in Stock Exchange markets, but, with its usual optimism, the House predicts better times "after Easter."

Northwich Electric Supply Co.—The directors recommend a dividend of 3 per cent., against nothing last year. There has been an increase of over 14,000 units of current sold for lighting and power. A further £5,000 capital is to be raised.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1901.	1902.	1903.	Closing Quotations Feb. 17th.	Closing Quotations Feb. 24th.	Business done week ended Feb. 24th, 1904. Highest	Lowest
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	98 —102	98 —102	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	2⅛— 3⅛	2⅛— 3⅛	..	..
119,700£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	..	..	..	70 — 80	.. — ..	..	..
788,840	Anglo-American Telegraph	Stock	61s.	60/6	61s.	50 — 53	50 — 53	50	..
3,105,880	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	94 — 96	94 — 96	95	94½
3,105,880	Do. do. do. Deferred	Stock	2s.	1/-	2s.	7⅛— 8	7½— 7⅝	7⅝	..
44,000	Chili Telephone, Nos. 1 to 44,000	5	5 %	5 %	..	4½— 5¼	4½— 5¼	..	..
13,333,300$	Commercial Cable	$100	8 %	8 %	..	180 —190	180 —190	..	..
1,841,209	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	89 — 91	89 — 91	90⅜	89¾
16,000	Cuba Telegraph	10	4 %	6½%	..	7 — 8	7 — 8	..	..
6,000	Do. 10 % Pref.	10	..	..	..	16 — 17	16 — 17	..	..
12,931	Direct Spanish Telegraph	5	4 %	4 %	..	2½— 3¼	2½— 3¼	..	..
6,000	Do. do. 10 % Cum. Pref.	5	..	..	..	7½— 8½	7½— 8½	..	..
80,000	Do. do. 4½ % Debs.	50	..	..	..	98 —101%	98 —101 %	..	..
60,710£	Direct United States Cable	20	3½%	3½%	..	10 — 10¼	9⅞ — 10⅛	10 1/16	9 15/16
85,800	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,200, Red.	100	..	..	..	98 —101	98 —101	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	..	119 —124	119 —124	121½	119½
1,955,565	Do. 8½ % Pref. Stock	100	..	..	..	87 — 90	87 — 90	..	..
1,534,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	105 —108	105 —108	..	..
800,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	..	10⅞— 11⅛	10⅞— 11⅛	11	10 15/16
820,003£	Do. 4 % Deb. Stock	Stock	..	..	..	104 —107	104 —107	..	..
300,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 3,000, red. 1909	100	..	..	..	98 —101	98 —101	..	..
200,000£	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	..	..	..	99 —102	99 —102	..	..
180,227	Globe Telegraph and Trust	10	5%	..	..	8⅛— 8⅜	8⅛— 8⅜	8 5/16	8⅛
180,042	Do. do. 6 % Pref.	10	..	..	..	12 — 12½	12⅛— 12⅜	12⅜	12⅛
150,000	Great Northern Telegraph, of Copenhagen	10	15 %	12½%	..	22 — 23	22 — 23	..	..
58,700	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	..	..	98 —101	98 —101	..	..
17,000	Indo-European Telegraph	25	10 %	10%	..	38 — 41	38 — 41	39¼	..
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	..	..	..	100 —103	100 —103	..	..
1,988,333	National Telephone, Pref. Stock	100	5 %	6 %	6 %	102 —104	103 —105	104	103½
1,966,667	Do. do. Def. Stock	100	..	4½%	5 %	78 — 81	78 — 81	79½	78½
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13½— 14½	13¾— 14½	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	14 — 15	14 — 15	14 7/8	14
2,250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	5½— 5⅝	5½— 5⅝	5½	..
600,000£	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	95 — 97	95 — 97	95½	..
600,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	100 —102	100 —102	101½	101½
179,313	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6 %	..	⅞— 1	⅞— 1	..	..
50,000	Do. do. do. 6 % Cum. Pref.	1	..	..	..	1 — 1⅛	1 — 1⅛	..	..
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	97 —100	97 —100	..	..
11,889	Reuter's	8	5 %	..	..	6½— 7⅛	6½— 7⅛	..	..
3,808	Submarine Cables Trust	Cert.	..	..	..	117 —122	117 —122	..	..
68,000	United River Plate Telephone	5	7 %	7 %	..	5½— 6	5½— 6	..	..
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	4⅞— 5⅛	4⅞— 5⅛	..	..
179,947£	Do. do. 5 % Debs.	Stock	..	..	..	102 —105	102 —105	..	..
15,609	West African Telegraph, Shares	10	..	2 %	..	5 — 6	5 — 6	..	..
150,000£	West Coast of America, 4% Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	..	..	..	95 — 98	95 — 98	..	..
207,980	Western Telegraph, Ltd., Nos. 1 to 207,980	10	7 %	7 %	..	11⅞— 12¼	11⅞— 12¼	11⅞	11⅞
75,000£	Do. do. 5 % Debs. 2nd series, 1906	100	..	..	..	99 —102	99 —102	..	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	98 —101	98 —101	..	..
88,821	West India and Panama Telegraph	10	..	..	..	⅜— ½	⅜— ½	..	..
34,568	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	6 — 6¼	6 — 6¼	..	..
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	4½— 5¼	4½— 5¼	..	..
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	..	..	..	99 —102	99 —102	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

20,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	4 — 5	4 — 5	..	..
800,000£	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	..	..	..	87 — 91	87 — 91	..	..
100,000	British Electric Traction	10	9 %	8 %	..	9⅛— 10⅛	9⅛— 10⅛	10⅛	9⅝
100,000	Do. do. 6 % Cum. Pref.	10	..	..	..	10 — 11 xd	10⅛— 11⅛	11 1/16	10⅛
600,000£	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	120 —123	120 —123	122½	121½
100,000	British Insulated and Helsby Cables	5	10 %	10 %	..	6 — 6⅛	6 — 6⅛	..	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	5¼— 5⅜	5¼— 5⅜	..	..
80,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	..	..	..	102 —107	102 —107	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	..	..	9/16— 11/16	9/16— 11/16	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	6 %	..	..	14/6 to 15/6	14/6 to 15/6	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	Nil	Nil	..	½— 1⅛	½— 1	..	..
150,000	Do. do. Non-cum. 6 % Pref.	2	3 %	6 %	..	1¼— 1⅜	1 — 1⅛	..	..
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	97 —100	98 —101	..	..
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	75 — 80	75 — 80	..	..
85,000	Callender's Cable Construction shares	5	20 %	15 %	..	10½— 11½	10¾— 11¾	..	..
40,000	Do. do. do. 5 % Cum. Pref.	5	..	..	..	5¼— 5⅜	5¼— 5⅜	5½	..
90,000£	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	104 —108	104 —108	..	..
1,860,014	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	93 — 96 xd	91 — 94	94	92
494,998	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	96 — 99 xd	96 — 99	99	..
494,998	Do. do. Def. do.	Stock	4 %	4 %	4 %	87 — 90 xd	86 — 89	..	..
1,380,000	City and South London Railway	Stock	2 %	3½%	2½%	49 — 52 xd	49 — 52	50⅜	..
85,000	Crompton & Co., Nos. 1 to 85,000	8	7½%	5 %	..	1½— 2	1½— 2	..	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	97 —100	96 — 99	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,261	5	Nil	Nil	..	0 — ⅛	0 — ⅛	..	..
17,139	Do. do. "A" shares, 01—017,139	5	Nil	Nil	..	⅛— 1/16	⅛— 1/16	..	..
344,023£	Do. do. 4 % Deb. Stock Red.	Stock	..	..	..	72 — 77	72 — 77	..	..
100,000£	Do. do. 5 % 2n Deb. Stock Prov. Certs. all pd.	100	..	..	..	76 — 81	76 — 81	..	..
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	..	1½— 1⅝	1½— 1⅝	..	..
31,890	Do. do. 7 % Cum. Pref., 1 to 31,890	2	..	..	..	2⅞— 3	2⅞— 3	..	..
82,500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	97 —100	97 —100	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	..	9¼— 9⅜	9¼— 9⅜	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	95 — 98	95 — 98	..	..
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	20 %	..	12 — 13	12 — 13	13	..
35,000	Do. do. 4½ % Pref.	5	..	..	..	5 — 5⅛	5 — 5⅛	..	..
48,050	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	108 —112	108 —112	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	..	18⅜— 19	18 — 19	18⅜	..
300,000£	Do. do. do. 4 % 1st Mort. Deb.	100	..	..	..	100 —103	100 —103	..	..
87,500	†Liverpool Overhead Railway, Ord.	10	1½%	1½%	..	4 3/32— 4 5/32	4 3/32— 4 5/32	..	..
10,000	† Do. do. Pref. £10 paid	10	..	..	..	9⅜— 10¼	9⅜— 10¼	..	..
87,350	Telegraph Construction and Maintenance	12	20 %	20 %	20 %	33 — 36	33 — 36	35	33½
150,000£	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	101 —104	101 —104	101½	..
540,000£	Waterloo & City Railway, Ord. Stock	100	3 %	3½%	3½%	91 — 94	91 — 94	..	..

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List.

Bank rate of discount 4 per cent. (September 3rd, 1903).

SHARE LIST OF ELECTRICAL COMPANIES (*continued*).—ELECTRICITY SUPPLY COMPANIES.

Present issue.	NAME.	Stock or Share.	Dividends for the last three years 1901.	1902.	1903.	Closing Quotations Feb. 17th.	Closing Quotations Feb. 24th.	Business done week ended Feb. 24, 1904. Highest.	Lowest.
100,000	Blackheath and Greenwich Dist. Electric Light, Ord...	‡ 1	..	..	..	⅜— 1	⅜— 1	..	..
50,000	Do. 7 % Pref.	1	..	..	..	1⅛— 1⅜	1⅛— 1⅜	..	..
100,000	Do. 4½% 1st Deb. Stock, Prov. Certs. ..	100	..	..	..	114 —117	115 —118	115	114½
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000	5	8 %	8 %	10 %	10½— 10⅝	10 — 10½	..	..
20,000	Do. do. 7 % Cum. Pref. ..	5	..	..	..	9⅜— 10½	9⅜— 10½	..	..
250,000	Central Electric Supply 4 % Guar. Deb. Stock	100	..	..	..	106 —109	106 —109	..	..
60,000	Charing Cross and Strand Electricity Supply	5	10 %	10 %	8 %	7⅜— 8½xd	7⅜— 8⅝	7⅝	..
70,000	Do. do. do. 4½% Cum. Pref.	5	..	..	..	5⅜— 6⅜xd	5½— 5¾	5⅝	..
40,000	Do. do. "City Undertaking" 4½% Cum. Pref.	5	..	..	..	4⅜— 5	4⅜— 5	4⅜	..
40,000	Do. do. 1903	5	..	..	..	4⅜— 5	4⅜— 5	4⅜	..
250,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	102 —104	102 —104	102	..
44,436	*Chelsea Electricity Supply, Ord.	5	4 %	4⅓%	5⅓%	5½— 6½	5½— 6½	5⅛	5½
150,000‡	Do. do. % Deb. Stock Red.	Stock	..	..	..	106 —109	106 —109	..	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595 ..	10	5 %	5 %	5 %	10½— 11½	10⅜— 11½	11	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	..	..	..	13 — 14	13 — 14	..	..
400,000‡	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid ..	..	..	..	..	121 —126	121 —126	..	..
800,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	..	..	..	101 —104	101 —104	103½	..
40,000	County of London & Brush Prov. Electric Lighting, Ord. 1—40,000..	10	4 %	4 %	..	8 — 9	8 — 9	..	..
20,000	Do. do. do. 6 % Pref., 40,001—60,000..	10	..	..	..	11½— 12½	11½— 12½	11⅜	11⅛
400,000‡	Do. do. 4½% Deb. Stock	..	..	..	..	107 —110	106 —109	..	..
250,000	Do. do. 4½% 2nd Deb. Stock	Stock	..	..	..	99 —102	99 —102	100½	..
50,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	..	5⅜— 6½	5⅜— 6½	..	..
80,000	Do. do. 6 % Cum. Pref.	..	..	..	..	5⅜— 6½	5⅜— 6½	..	..
140,000	Do. do. 4½% 1st Mort. Deb. Stock ..	100	..	..	..	103 —106 xd	103 —105	104⅛	..
21,000	Kensington and Knightsbridge Electric, Ord.	5	10 %	10 %	12½	11 — 12	11 — 12	..	..
90,000	Do. do. do. 4 % Debenture Stock ..	Stock	..	..	..	102 —105	103 —106	..	..
110,000	London Electric Supply Corporation, Limited, Ord.	3	..	..	..	1⅞— 2⅛	1⅞— 2⅛	..	..
49,840	Do. do. do. 6 % Pref.	5	..	..	..	5⅛— 6	5⅛— 6	..	..
250,000‡	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock	..	..	..	95 — 98	95 — 98	..	..
100,000	Metropolitan Electric Supply, 1 to 100,000	10	6⅔%	7⅓%	..	17⅞— 18⅝	17⅞— 18⅝	18⅛	17⅞
71,106	Do. do. 4½% Cum. Pref. 1—71,106, £3 paid ..	5	..	..	..	5⅛— 5⅜	5⅛— 5⅜	5⅜	5⅛
220,000‡	Do. do. 4½% 1st Mort. Deb. Stock	..	..	..	..	109 —113	109 —113	..	..
250,000‡	Do. do. 3½% Mort. Deb. Stock Red	Stock	..	..	..	95 — 98	95 — 98	..	..
10,852	Notting Hill Electric Lighting	10	6 %	6 %	6 %	13 — 14	13 — 14	..	..
50 000	Do. do. 4 % First Mort. Debs.	100	..	..	..	99 —102	99 —102	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	14 — 15	14 — 15	14⅝	14½
20,000	Do. do. do. 7 % Pref. 20,081 to 40,080	5	..	..	..	8 — 9 xd	8 — 9	..	..
150,000‡	Do. do. do. 3½% Deb. Stock Red ..	100	..	..	..	97 —100	97 —100	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	2½%	4 %	3¾ — 3¾	3¾ — 3¾	..	..
50,000	Do. do. do. 4 % Deb. Stock	Stock	..	..	..	85 — 90	85 — 90	..	..
65,000	South London Electricity Supply, Ord.	5	1⅜%	3 %	3¾ — 4¼	3¾ — 4¼	..	..
80,000	Urban Electric Supply, Ord.	5	..	..	4⅜ — 5	4⅜ — 5	..	..
80,000	Do. do. 5 % Cum. Pref.	5	..	..	4⅞ — 5⅛	4⅞ — 5⅛	4⅝	..
110,000	Westminster Electric Supply, Ord.	5	10½%	12 %	13½%	12⅜— 13⅛	12⅜— 13⅛	13⅛	13⅛
28,141	Do. do. 5 % Cum. Pref.	5	..	..	..	6 — 6⅛	6 — 6⅛	6 1/16	..

* Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS, Wednesday, February 24th.

CHEMICALS, &c.

		Latest Price.	Week's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a ,, Nitric	per cwt.	22/-	..
a ,, Oxalic	per cwt.	32/-	..
a ,, Sulphuric	per cwt.	5/6	..
a Ammoniac, Sal	per cwt.	42/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	..
a ,, ,, ...	per ton	£30	..
a Bleaching powder	per ton	£4 10	..
a Bisulphide of Carbon	per ton	£15	..
a Borax	per ton	£18	..
a Benzole (90 %)	per gal.	7/-	..
a ,, (50/90 %)	per gal.	5/6	..
a Copper Sulphate	per ton	£23	..
a Lead, Nitrate	per ton	£24	..
a ,, White Sugar	per ton	£31	..
a ,, Peroxide	per ton	£27 10	..
a Methylated Spirit	per gal.	2/6	..
a Naphtha, Solvent (90% a 160° C).	per gal.	5/6	..
a Potash, Bichromate, in casks ..	per lb.	3d.	..
a ,, Caustic (75/80%)..	per ton	£24	..
a ,, Bisulphate	per ton	£35	..
a Shellac	per cwt.	220/-	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6 10	..
a ,, Recovered	per ton	£5 10	..
a ,, Lump	per ton	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	..
a ,, Crystals	per ton	£3	..
a ,, Bichromate, casks.. ..	per lb.	2½d.	..

METALS, &c.

b Aluminium Ingots, in ton lots ..	per ton	£130	..
b ,, Wire, in ton lots ..	per ton	£168	..
b ,, Sheet, in ton lots ..	per ton	£166	..
p Babbitt's metal ingots	per ton	£43 to £130	..
c Brass (rolled metal 2" to 12") basis	per lb.	6¾d.	..
c ,, Tube (brazed)	per lb.	8¾d.	..
c ,, ,, (solid drawn).. ..	per lb.	7¾d.	..
c ,, Wire, basis..	per lb.	7d.	..
c Copper Tubes (brazed)	per lb.	9½d.	..
c ,, ,, (solid drawn) ..	per lb.	9¼d.	..
g Copper Bars (best selected ..	per ton	£70	..

METALS, &c. (*continued*).

		Latest Price.	Week's Inc. or Dec.
g Copper Sheet	per ton	£70	..
g ,, Rod	per ton	£70	..
e ,, (Electrolytic) Bars ..	per ton	£63	..
e ,, ,, Sheets ..	per ton	£73	..
e ,, ,, Rod ..	per ton	£75	..
e ,, ,, H.C. Wire	per lb.	7¼d.	..
f Ebonite Rod	per lb.	3/3	..
f ,, Sheet	per lb.	3/-	..
n German Silver Wire	per lb.	1/6	..
h Gutta-percha fine	per lb.	8/-	..
h India-rubber, Para fine	per lb.	4/5 to 4/5½	inc.
i Iron, Charcoal Sheets	per ton	£18	..
i ,, Pig (Cleveland warrants)	per ton	42/5	7d. dec.
i ,, Forgings, according to size	per ton	From £11	..
i ,, Scrap, heavy	per ton	47/6 to 50/-	..
i ,, Wire, galvanised No. 8 ..	per ton	£9 15	..
g Lead, English Ingot	per ton	£12 to £12 2 6	inc.
g ,, ,, Sheet	per ton	£13	..
m Manganin Wire No. 28	per lb.	8/-	..
g Mercury	per bot.	£8 5	..
d Mica (in original cases) small ..	per lb.	4d. to 1/6	..
d ,, ,, medium	per lb.	2/6 to 3/9	..
d ,, ,, large ..	per lb.	4/- to 7/9	..
p Phosphor Bronze, plain castings	per lb.	1/- to 1/2½	..
p ,, rolled bars & rods	per lb.	1/- to 1/8	..
p ,, ,, strip & sheet	per lb.	From 1/1	..
o Platinum	per oz.	£4	..
p Silicium Bronze Wire	per lb.	9d. to 11d.	..
i Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
i ,, ,, in bars		£15 to £40	..
g Tin, Block	per ton	£127 10 to £128 10	10s. dec.
g ,, Foil	per lb.	1/6	..
n ,, Wire, Nos. 1 to 16	per lb.	1/7½	..
p White Anti-friction Metals— "White Ant" brand ..	per ton	£12 to £62	..
j Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	8d.	..
j ,, 6 lea. Flax	per lb.	5½d.	..
j ,, 3 ply 10 lbs. Russian	per lb.	4½d.	..
j ,, 10 lbs. Russian, single ..	per lb.	4½d.	..
j ,, 120 lbs. Jute rove ..	per ton	£11	..
k Zinc, Sh't (Vieille Montagne bnd.)	per ton	£24 15	..

Quotations supplied by Messrs.:—*a* G. Boor & Co.; *b* The British Aluminium Co., Ltd.; *c* Thos. Bolton & Sons., Ltd.; *d* F. Wiggins & Sons.; *e* Frederick Smith & Co.; *f* India-Rubber, G.P. and Teleg. Works Co., Ltd.; *g* James & Shakspeare; *h* Edward Till & Co.; *i* Bolling & Lowe; *j* Walter H. Hindley and Co., Ltd.; *k* Morris Ashby, Ltd.; *m* W. T. Glover & Co., Ltd.; *n* P. Ormiston & Sons; *o* Johnson, Matthey & Co., Ltd.; *p* The Phosphor Bronze Co., Ltd.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS

	Locality.	Week ending	Receipts for the week. £	£*	No. wks.	Total to date. £	£*	Miles open.	*
British Electric Traction Co.	Aberdeen	Feb. 20	1,044	+211	38	46,261	+ 9,057	10	—
	Birmingham ..	,, 20	5,151	+296	8	41,108	+ 2,781	3½	—
	Bournemouth ..	,, 17	858	—	—	—	—	10½	—
	Blackburn	,, 19	716	+ 67	—	39,534	+ 1,934	13½	—
	Blackpool	—	—	—	—	—	—	8½	—
	,, —Fleetw'd	,, 20	179	— 22	8	1,366	— 38	7½	—
	,, —Lytham	,, 18	146	—	16	2,354	+ 1,775	7½	—
	Bolton	,, 21	1,622	+113	47	85,201	+ 9,035	25	—
	Bradford	,, 21	3,545	+869	45	175,185	+22,633	78	+1
	Brighton	,, 21	711	— 5	—	42,057	—	7½	—
	Bristol	,, 19	4,242	—171	—	—	—	28	—
	Devonport ..	,, 12	457	+ 84	6	2,816	+ 464	5	—
	Dudley—Sto'rb'ge	,, 12	732	+ 16	6	4,355	+ 185	18½	—
	Gateshead ..	,, 12	864	+ 36	6	5,288	+ 269	10½	+ ¾
	Gr'n'k—Pt. Glsgw	,, 12	418	+ 71	6	2,579	+ 440	7½	—
	Hartlepool ..	,, 12	941	+ 20	6	1,701	+ 197	6½	+2
	Middleton.. ..	,, 12	247	+ 21	6	1,473	+ 89	8½	—
	Oldham—Ashton	,, 12	489	— 30	6	2,983	— 192	8	—
	Potteries	,, 12	1,692	+240	6	9,798	+ 651	28½	—
	Southport	,, 12	219	+ 1	6	1,444	+ 146	5½	—
	South Staffs. ..	,, 12	767	+ 86	6	4,416	+ 297	21½	—
	Swansea	,, 12	510	+ 74	6	3,891	+ 113	5½	—
	Wolverhampton..	,, 12	883	— 9	6	1,964	— 64	10½	+8
	Yorks. Wool Dist.	,, 12	490	—	6	3,005	—	6	—
	Miscellaneous ..	,, 12	1,229	—	6	7,388	—	—	—
	Burnley	,, 20	567	+200	—	—	—	7½	—
	Burton-on-Trent ..	,, 21	291	—	29	10,003	—	8½	—
	Cardiff	,, 13	1,912	+347	—	89,755	+22,587	1	—
	Chatham & District	,, 18	512	+184	7	3,583	+ 801	8·53	—

* Compared with the corresponding period of 1903.

	Locality.	Week ending	Receipts for the week. £	£*	No. wks.	Total to date. £	£*	Miles open.	*
	Cork	Feb. 18	381	— 14	7	2,760	+ 17	9	—
	Dover	,, 20	162	— 8	7	1,225	— 58	3	—
	Dublin	,, 19	4,216	—307	8	31,040	+ 539	47	+ ½
	East Ham	,, 20	600	+101	—	30,867	+ 8,473	5	+ ½
	Glasgow	,, 20	12,918	+423	38	517,499	+52,528	69½	+5½
	Halifax (2 weeks) ..	,, 10	2,195	+121	45	60,181	+ 6,308	31½	+1½
	Huddersfield ..	,, 20	1,119	+120	—	—	—	—	—
	Hull	,, 20	1,987	+323	47	89,687	+ 7,087	18	+2
	Ilkeston	,, 17	118	—	—	—	—	3½	—
	Ipswich	,, 20	314	—	—	3,871	—	9	—
	Isle of Thanet ..	,, 20	233	— 17	7	1,513	— 100	10½	—
	Leeds	,, 20	4,956	+293	—	255,055	+15,545	41	—
	Liverpool	,, 13	9,471	+ 59	7	66,868	+ 2,742	103	—
	London C. C. ..	,, 20	9,653	+1349	46½	458,670	+80,327	39½	—
	Manchester	,, 20	10,572	+2450	—	541,602	+281,075	72	—
	Newcastle	,, 20	3,482	+421	—	—	—	17	—
	Portsmouth	,, 20	1,342	+114	—	80,702	+ 6,362	14½	—
	Salford	,, 15	3,568	+693	—	175,176	+48,807	30	—
	Sheffield	,, 21	4,293	+333	47½	214,606	+17,238	32½	+4½
	Southampton ..	—	—	—	—	—	—	16½	—
	Southend-on-Sea ..	,, 17	216	+ 33	46	14,397	+ 2,214	8	—
	Sunderland	,, 21	1,061	+ 94	47	58,604	+ 2,701	20	+3
	Tyneside	,, 17	288	+ 45	7	1,884	+ 406	8·9	+·43
	Wolverhampton ..	,, 21	836	— 2	—	—	—	5½	—
	Cen. London Rly. ..	,, 20	7,096	+164	8	55,979	+ 406	6	—
	City & S. Lon. Rly.	,, 21	3,177	+109	8	25,763	— 617	6½	—
	Dublin—Lucan Rly.	,, 22	95	+ 2	8	696	+ 88	6½	—
	L'pool Overh'd Rly.	,, 21	1,472	+ 4	8	12,217	+ 358	6½	—
	Mersey Railway ..	,, 20	1,482	+297	7	10,067	+ 2,545	4½	—

"GUTTA GENTZSCH."

An Insulating Substance Recently Introduced into England.

The New Gutta-Percha Co., Ltd., have now completed the first instalment of plant and machinery at their factory at Greenwich for producing an insulating material which they call "Gutta Gentzsch," and which has already achieved a remarkable measure of success on the Continent. Many and various have been the attempts to produce a gutta-percha substitute, but hitherto without success, for reasons which will be familiar to most electric cable manufacturers.

Through the courtesy of the directors of the New Gutta-Percha Co., Ltd., we recently had an opportunity of inspecting their factory at Greenwich. A steam engine capable of indicating 150 H.P., together with the necessary boiler plant, drives the machinery, which is of a very simple character, and in the design of the buildings provision has been made for future extensions, so that the output could be largely increased at a relatively small further capital expenditure.

Mr. Ed. C. de Segundo, A.M.I.C.E., the engineer of the New Gutta-Percha Co., Ltd., frankly admits that when he was retained to investigate the merits of this substance two years ago he entered upon his investigations in a very sceptical spirit, but that after witnessing the manufacture of the material at the inventor's factory in Austria, and after hearing the evidence of Messrs. Felten & Guilleaume, who had already manufactured a number of submarine telegraph cables for their own purposes and for the Imperial Post Office of Germany, he could come to no other conclusion than that this material marked an important advance as an insulating medium upon any other that had hitherto found its way on to the market. Some preliminary experiments which he caused to be made in England by independent authorities who were at least as sceptical as he was, confirmed this view, and, judging by the details we give further on, there can be little doubt now that "Gutta Gentzsch" should in the near future play an important part in the insulation of submarine cables, particularly as the growing scarcity of gutta-percha and the consequent enhancement of its price have rendered the use of pure unadulterated gutta-percha almost prohibitive, and have conduced to the admixture of other substances with gutta-percha, which, of course, materially lowers the quality.

Various mixtures are employed in making up the "Gutta Gentzsch" according to whether it is designed for use as a substitute for gutta-percha in the insulation of submarine cable cores, or whether as an insulator for electric light wires and cables for use on land.

The Imperial Post Office of Germany have subjected the material to the hardest possible test, namely, in the insulation of submarine telegraph and telephone cables. Three official certificates in all have been issued by the German Post Office—the first in November, 1900, the second in May, 1902, and the third in May, 1903. Previous to their first report the German Post Office had been occupied with laboratory and practical tests for several years, so that they have gone very thoroughly into the matter, and the official certificate issued in May, 1903, was of the nature of a final one, and was to the effect that the cables which had been laid, and which had been in practical use, had given every satisfaction. In December of last year Mr. de Segundo was informed by the head of the Telegraph Department at Berlin that several more cables had been laid during the year, and that the authorities intended to extend its use in this direction, as they were perfectly satisfied with its behaviour.

From the above it will be seen that "Gutta Gentzsch" is by no means of mushroom growth. As a matter of fact, Mr. Adolf Gentzsch, the inventor, had spent upwards of six years in experimental research before he succeeded in producing a material which possessed the necessary qualities to form the basis of a proper substitute for the natural gutta-percha, and a further considerable period elapsed before his practical tests enabled him to fix upon the proper ingredients and proportions to enable him to take out Letters Patent for the material, which were granted to him without any difficulty whatever in Germany and all the European countries, and in America. The German, Austrian and other of the European patents have been acquired by one of the most powerful electric manufacturing firms on the Continent, and the New Gutta-Percha Co., Ltd., have acquired the British and Colonial and some of the European patents.

It will be of interest to our readers to say a few words upon the physical and electrical properties of this material. The leading characteristics are:—

1. The dielectric resistance is equal to that of natural gutta of similar quality. The softening point is considerably higher than that of natural gutta-percha ("Gutta Gentzsch," about 130°; real gutta, about 100°).

2. In the case of submarine cores the capacity rises for some weeks after immersion, but attains a constant value which compares well with the inductive capacity of similar-sized real gutta-percha cables.

3. The price is very much lower than that of real gutta-percha.

4. The specific gravity is about the same as that of water.

5. "Gutta Gentzsch" cools more rapidly than real gutta-percha, this being an important advantage from a practical standpoint in the covering of wires with the material.

6. The resistance of "Gutta Gentzsch" to the influence of oxidation and of the effect of light is remarkably great, as compared with natural gutta, which, as is well known, soon becomes hard and brittle, and entirely loses its valuable properties when exposed to light and air, particularly in dry positions.

With regard to this latter property, two experiments may be mentioned. One was carried out by Dr. Weber, who exposed thin sheets of "Gutta Gentzsch" and of natural gutta to the continuous action of pure oxygen at a temperature of 86° F. for eight days and nights, at the end of which the natural gutta had become so oxidised as to fall to pieces on handling, whereas, the "Gutta Gentzsch" was very little oxidised and was practically unchanged as regards suppleness.

A corroboration of this is found in the behaviour of a coil of wire which Mr. de Segundo tells us was covered with "Gutta Gentzsch" in his presence in February, 1902, and is therefore two years old. During this time the wire has been in his possession and has lain on a table in his office exposed to to the atmosphere and to sunlight. Mr. de Segundo handed us a piece of this wire which we found we could twist until the copper conductor broke, without breaking the "Gutta Gentzsch" covering. This is certainly a remarkable result. We notice that Mr. Swinburne also refers to this peculiar characteristic of the material. He says in his report: "The insulating compound is tough, and does not suffer from bending. We were able to break the 7-strand copper by repeated bending and twisting without breaking the insulation outside of it."

Owing to insular prejudice, which is a prominent characteristic of the mind of the average untravelled Englishman, the directors of the New Gutta-Percha Co. found it necessary to repeat in this country some of the tests to which the material had been subjected on the Continent, and with a view to obtaining the highest independent testimony, they requested Mr. James Swinburne (late President of the Institution of Electrical Engineers) to test half-a-mile of "Gutta Gentzsch" core (130/130) which was identical with that supplied by Messrs. Felten & Guilleaume to the German Post Office. Simultaneously a test of a similar length of core was commenced at the works of Messrs. Felten and Guilleaume, and subsequently this core was shipped over to England and immersed in a tank at Mr. Swinburne's office for further test. The results of the tests, which extended over a year, have been most satisfactory. The material showed a gradual increase in the inductive capacity for about five or six months after manufacture, at the end of which time it became, and remained, constant. This was the invariable experience of Messrs. Felten and Guilleaume, and of the German Post Office who test their "Gutta Gentzsch" cables every week. The inductive capacity at first was very much lower than that of similar gutta-percha cable, but eventually rose to, and remained constant at, a value which, as Mr. Swinburne points out in his report, compares favourably with that of real gutta-percha core of the same dimensions. The dielectric resistance does not, however, rise as in the case of a real gutta-percha core, but, as reported by Mr. Swinburne, remains constant after the inductive capacity has reached its constant value, within the limits of personal error and measurement.

Samples of the material were also submitted to the well-known rubber expert, Dr. Carl Otto Weber, Ph.D., of Manchester, who investigated the merits of the material from

a chemical standpoint. In his report Dr. Weber comments very strongly upon the remarkable properties and characteristics of the material, and concludes his report by stating that "For the applications in which at the present time the bulk of the natural gutta-percha is consumed, the 'Gutta Gentzsch,' both by reason of its chemical composition as also of its physical structure appears to be eminently suitable."

A coil of "Gutta Gentzsch" core was submitted in the early part of last year to our postal authorities at St. Martins-le-Grand and was tested by them for several months; as a result the company received a small trial order of 5 miles, which was recently delivered to the Post Office and is now in use. Trial orders were received from several of the railway companies in the autumn of last year, and repeat orders on a commercial scale have since been received by the company, in fact, one of the leading railway companies in England has accepted the New Gutta-Percha Co.'s tender for the supply of "Gutta Gentzsch" wire for the ensuing year.

The New Gutta-Percha Co. have recently received from the Danish Government an invitation to tender for the supply of submarine telephone cables, in the specification for which it is set forth that the insulating medium is to be "Gutta Gentzsch." The Danish Government have been led to adopt "Gutta Gentszch" from the satisfactory replies received from the Imperial Post Office of Germany to their inquiries as to the behaviour of this material. The fact of "Gutta Gentzsch" being specified by a second Government Department is undoubtedly a striking testimony of the growing confidence in the value of "Gutta Gentzsch" as a substitute for the natural gutta-percha.

An important feature of the "Gutta Gentzsch" is the simplicity of the process and the comparatively low price at which it can be sold. We are informed that the particular grade suitable for the insulation of submarine cable cores can be produced at a cost which would enable it to be sold at a price considerably below that of natural gutta-percha. It must be borne in mind that natural gutta-percha has to be paid for according to the shipping weight at Singapore, or wherever it comes from. It may lose from 10 to 15 per cent. in moisture on the voyage over, and it suffers a further loss of weight which is usually between 30 and 40 per cent. owing to the dirt and other foreign elements which have to be removed by a process of washing, whereas, the "Gutta Gentzsch" is supplied in a form in which it is ready for immediate use in the covering machines without having to undergo any preliminary processes. This, of course, very greatly simplifies the procedure in insulating wires.

It must not be inferred that the field for "Gutta Gentzsch" is limited to its being used as a substitute for natural gutta-percha, as its name would seem to imply. As a matter of fact, it has already been determined that "Gutta Gentzsch" can be employed successfully, both electrically and commercially, as an insulating medium for electric light wires and cables, which are now insulated with vulcanised india-rubber, and the reason is not far to seek. It is well known that vulcanised india-rubber cables do not stand well in damp places, whereas damp does not appear to affect "Gutta Gentzsch" at all. In this regard it behaves more like the natural gutta-percha. Further, the specific gravity of the rubber mixtures which are used for the good quality of insulated wires and cables, ranges from the minimum of 1·5 to 1·7 and even higher; whereas the specific gravity of "Gutta Gentzsch" is very little higher than that of water. In fact, "Gutta Gentzsch" floats when it is warm and gradually sinks when cold, the specific gravity being about 1·03, but varying slightly with the various qualities. These two circumstances, taken in conjunction with the comparative hardness of the material as compared with gutta-percha, and its high dielectric resistance, should render it eminently suitable for the insulation of wires and cables and for a wide variety of other purposes, such as in the manufacture of belting, for boot soles, and for waterproofing and kindred purposes.

Sudbury.—The T.C. has signed an agreement with the Empire Electric Light and Power Co., whereby the company agrees to take over the Council's prov. order and to complete the entire works within nine months after commencement. The company are to pay the Corporation £750, and the prices for lighting are not to exceed 7d. per unit, and for power 4d. The Corporation have power after 21 years, and every subsequent five years, to purchase the undertaking.

THE USE OF ELECTRICITY IN MINES.

The Home Office has just issued a report of the Departmental Committee on the use of electricity in mines, with a set of rules to be observed in the installing and operation of the electrical plant. The Committee consisted of the following gentlemen:—Messrs. Henry H. S. Cunningham, C.B., Charles Fenwick, M.P., William Walker Hood, W. H. Patchell, M.I.E.E., W. N. Atkinson, and A. H. Stokes, the last two being H.M. Inspectors of Mines.

In the course of their inquiry the Committee consulted many gentlemen who, by their special knowledge of the question in its various aspects, could render advice and assistance. Several collieries were also visited for the purpose of inspecting their electrical equipments.

It is scarcely necessary to say that one result of the inquiry is a full recognition of the great advantages accruing from the use of electricity both for motive power and lighting. It is pointed out that the dangers attending the use of electricity are not greater, but often less, than those encountered in the use of explosives, while many dangers met with in mines are minimised or eliminated by the use of electrically-driven tools properly protected and carefully controlled. We take the following extract from the report:—

. . . . These powerful agencies may be made to play a most useful part in diminishing the severity of human toil. There can be no question that hand-hewing or holing and drilling of holes in coal and rock are very severe physical labour, and that they present dangers from which the use of machinery is free.

In order to hew coal the miners generally have to lie for hours under masses of coal which, if they fell, would immediately crush or severely wound them; and a proportion of the yearly roll of mine accidents is due to this cause. But if a fall occurs at the face where a coal-cutter is being employed, it will often only be the machine that is damaged.

When, therefore, we reflect upon the mitigation of severe and exhausting labour, and the far greater efficiency that the use of electricity is likely to produce, which ought to result in benefit to the miner, the consumer, and the coal owner alike, we have no hesitation in saying that this new agent ought to be welcomed.

The representatives of the owners and of the miners fully appreciate these views, and of the numerous witnesses who appeared before us there was not one, whether owner, engineer, manager or miner, who offered the least objection to the use of electricity when proper precautions were taken.

But although we are prepared to advise that the fullest latitude should be given to the great development of electrical machinery in mining, which we believe is about to take place, we desire to record our emphatic opinion that those who are to use it, and to be exposed to any dangers that may arise from it, have a right to demand that every precaution should be taken that is reasonably possible to secure their safety.

But the application of electricity to mining work is still in its initial stages. The practice and opinions of engineers differ considerably, and it is therefore by no means easy or desirable to prescribe too rigidly the systems that ought to be employed. There are conflicting opinions about cable-laying. Some want the cables armoured, others think armouring a source of danger; some bury them in the ground, others hang them along the roof or sides, some advocate casing, others prefer to keep them constantly in view. Again, as regards the limits of pressure to be employed, some consider that 500 volts should be the maximum; others think that high alternating voltages are a necessity, and point to their use in Germany and other countries in coal mines upon a large scale. These differences render it very difficult to prescribe details, for by so doing some useful paths of progress might be debarred. On one point, however, we observed that all witnesses were agreed, namely, that the apparatus should always be thoroughly well made and erected, and all the parts well protected from accident, and the dangerous parts from coming into contact with the workmen.

Following on these broad lines, the Committee consider that the general principles which should govern the employment of electricity in mines are as follows:—

1. The electric plant should always be treated as a source of potential danger.

2. The plant, in the first instance, should be of thoroughly good quality, and so designed as to ensure immunity from danger by shock or fire; and periodical tests should be made to see that this state of efficiency is maintained.

3. All electrical apparatus should be under the charge of competent persons.

4. All electrical apparatus which may be used when there is a possibility of danger arising from the presence of gas, should be so enclosed as to prevent such gas being fired by sparking of the apparatus; when any machine is working, every precaution should be taken to detect the existence of danger, and on the presence of gas being noticed, such machines should be immediately stopped.

For the purpose of dealing with the various uses of electricity in mines, observations are made under nine distinct headings, viz. :—

1. Generating stations.
2. Cables, switches, fuses, &c.
3. Stationary motors.
4. Portable motors for coal-cutters, drills, &c.
5. Electric locomotives.
6. Electric lighting.
7. Shot-firing.
8. Signalling.
9. Electric re-lighting of safety lamps.

1. The chief features under this heading are proper switchboard arrangements with every facility for altering or making connections without undue risk of shock, and provision against leakage to earth.

2. The observations here are numerous, but the chief points are the necessity of thoroughly efficient insulation and of installing the cables in such a manner as to avoid risk of accident due to fall of coal or any other form of mechanical injury. A periodic examination of all cables is strongly recommended.

Switches, fuses and automatic circuit-breakers should only be accessible to authorised persons, and when in places which may be affected with fire-damp should be placed in flame-tight enclosures.

3. Stationary motors should be placed in specially constructed enclosures, accessible only to authorised persons, and ventilated with intake air. Where the presence of gas is to be feared, the enclosures should be flame-tight.

4. The following principles should govern the use of portable motors :—

(*a*) The man in charge, being a practical pit-man, should be provided with a safety lamp, with which he could detect the presence of gas, and should make frequent examinations with this lamp.

(*b*) Where gas is found, the machine should cease working, and the current be switched off at the gate-end switch-box, until the gas has been removed.

(*c*) Frequent examination should be made of the trailing cables to detect wear and tear or abrasion of the insulation ; and in the event of substantial damage to the insulation being discovered, the machine should cease running until the damaged cable has been replaced or repaired.

(*d*) Trailing cables should first be attached to the machine, and last of all connected to the gate-end switch-box.

(*e*) The attachment to both the machine and the gate-end switch-box should be so arranged that no strain can come on the actual current-carrying contacts.

(*f*) All terminals should be completely enclosed in a flame-tight casing.

(*g*) The motor casing also should be flame-tight, and of sufficient strength to resist damage from an internal explosion or from a fall of roof.

(*h*) Before replacing the motor casing, precautions should be taken to ensure that the joints will be flame-tight when the casing is bolted down.

5. The adoption of electric locomotives for haulage in mines is strongly deprecated where there is any possibility of danger from ignition of gas.

6. Lighting by electricity is advocated, precautions being taken to avoid breakages by mechanical shock, and due care being exercised to protect the cables.

7. Shot-firing by means of electricity is strenuously and emphatically advocated since it partly eliminates, or, at any rate, very largely reduces the risk of accidents from hang-fires, a danger which is always present where safety-fuse is employed.

8. Electrically-worked signals are strongly advocated, and expression of opinion is given that all motor rooms should be connected by telephone to the power house, so that the attendant can at once inform the electrician in charge of the power house of any breakdown of the machinery, and speedily obtain assistance if required. The opinion is also expressed that in those parts of a mine in which gas is to be feared, it is unnecessary to exceed a pressure of 10 volts for signalling purposes.

9. The electric re-lighting of safety lamps should be in charge of a competent man, who could examine each lamp brought for re-lighting before re-issuing it.

The conclusion of the report is as follows :—

In order to assist the Department, and also to put our views into a definite shape, we have drawn up a set of rules which we think might with advantage be introduced into all mines. They are rather lengthy, and from their multiplicity may create alarm, but we do not see our way to deal with the subject effectively except by some code such as we propose.

We think, however, that if this code, or one like it, is established, a considerable step will have been made towards securing the safety of miners, and that it will be impossible, under such provisions, that many casualties will occur.

Of course, this code will not put an end to accidents. No code that can be devised could do so, and numerically, as the use of electricity grows, the bare number of accidents may be expected even to increase. But, on the other hand, for reasons we have given, we shall hope that accidents from falls at the face will more than correspondingly diminish. At any rate, according to our proposals, both owners and men will have the satisfaction of feeling that good work and appliances are insisted on, and that dangerous apparatus is fenced and isolated, and that the improper use or tampering with electricity is strictly forbidden. No doubt alterations may be needed, but, taking into account the expense and interruption of work which changes in electrical plant and rules involve, and the trouble it gives to miners to add to or change the already considerable body of rules which, under penalty, they are bound to obey, we hope that whatever code is established, a fair trial will be given to it, and that it will not be altered except for real reasons of necessity.

And we certainly hope that we have been able to indicate the main characteristics that will be required, so that if the Secretary of State should see fit to adopt our main conclusions, owners may prepare to put in electricity, and men may prepare to learn to manipulate the new agent, in confidence that their labour and expense and trouble will not be wasted, and we further hope that any changes that subsequent experience may render necessary, will be matters of detail, and not involve fundamental alterations of the principles which we have submitted as the best method of securing the full advantages of electricity consistently with a proper regard to the safety of all engaged in working in mines.

In the body of the report it is recommended that, except in special cases, no pressure higher than 650 volts should be used.

Following the report, a set of rules is drawn up. As these are somewhat lengthy and number 115, we cannot in our available space quote them in detail. Suffice it to say, that they are generally in accordance with the report, and are constructed particularly to avoid accidents from shock or fire.

The Committee appointed to investigate and report upon the use of electricity in mines have spared no pains to obtain information on the subject. They have consulted, and taken advice from, people who by their practical knowledge of electrical plant and intimate acquaintance with the dangers attending the operation of such apparatus in mines were best capable of giving advice.

We have no comment to make upon their conclusions as to the management of the electrical plant either during the installation or the subsequent operation, but we do think that, while latitude should be given in the choice, stronger recommendation as to the safer class of machinery should be given.

We quote an extract from the report to illustrate our contention :—

Electric currents may be broadly classed under two heads—continuous currents and alternating currents, which both possess a special suitability for different purposes.

It is no part of our business to decide which of these systems is the best adapted for use in mines. The alternating system, in spite of its greater complications, especially when three-phase current is employed, seems well adapted for long-distance transmission, and we also had evidence as to the successful working of heavy winding and pumping machinery by it in Germany. At the present time there is a strong leaning on the Continent to the use of three-phase current, and in America one company alone is reported to have, either in hand or delivered, plants aggregating to over 1,000,000 H.P., the bulk of which appears to be in connection with long-distance transmission schemes. The general tendency in American mines is, however, to the use of continuous current plant. Possibly this is influenced by the large use of locomotives on this system.

It seems very probable, therefore, that the solution, at any rate, for large schemes, will be alternating current for generation and transmission. As regards the kind of current likely to be used for motors, up to the present those which have to be frequently started and stopped have been most successful on the continuous current system, but we hope that the progress now being made in the improvement of alternating current motors will lead to the development of a thoroughly reliable motor without commutator or rubbing contacts, which can be started and run without causing a disturbance on the system or necessitating elaborate starting gear. It is evident that for use in fiery mines a motor without parts liable to sparking is preferable to one with such parts, no matter how well designed the boxing-in may be.

The use of the three-phase system has been somewhat restricted in this country, but it seems probable that in the near future its employment will be largely extended, owing to the advantages it

presents for transmitting power from a central generating station to scattered collieries, and its adaptability for obtaining varying voltages by means of transformers. In our opinion this system deserves the careful attention of all who intend to install electricity in mines.

The weakness of this is a failure to grasp the fact that sparkless induction motors fulfil all the requirements for driving the tools used in mines, and more especially those portable tools used for actual coal cutting where the danger of firing inflammable gas is the greatest. It is not necessary for any of these motors to start under load, and consequently they can be started and stopped quite as easily as any continuous-current motor.

It is impossible to design a continuous-current motor for absolutely sparkless commutation under widely-varying loads, and consequently their use is always accompanied by grave danger, even though they may be enclosed in flame-tight cases, wherever fire damp is likely to occur.

We can from personal experience state that sparkless induction motors—that is, motors with squirrel-cage rotors—are now built so that they are quite as efficient, and maintain almost as constant a speed as the best shunt-wound motors giving the same output. It is true that they take slightly more current at any particular load than a direct-current motor for the same output, but they never spark, unless burnt out (which is a very rare occurrence), they can stand greater overloads without undue heating, and they are in every respect mechanically stronger, and more durable than any continuous-current machine. No fall at the face would be likely to seriously damage an induction motor provided the stator windings were protected by a strong metal covering, and no flame-tight covering would be necessary. While agreeing with all the remarks in the report regarding the great advantages possessed by alternating currents as regards generation and transmission, we wish here to emphasise our opinion that the Committee have altogether missed their mark in not recognising the far greater advantages possessed by alternating-current motors over direct-current motors where dangers exist, as in coal mines, of disastrous explosions caused by one little spark. It is a matter of little moment whether the installation be single-phase, di-phase, or tri-phase; there are motors of all three types meeting the requirements, all reliable and all sparkless.

SMALL GAS ENGINES v. ELECTRIC MOTORS.

Gas engines operated under favourable conditions are certainly economical as a source of power, and it is often very difficult to persuade users to abandon them in favour of an electric motor.

The majority of small engines used in builders' and engineers' shops, in mineral water manufacture, refrigerating, sawmills, brickfields, &c., work very intermittently, and the duty done is usually vastly over-estimated by the owner, who is therefore satisfied that his gas bill is very moderate.

The power represented by such engines would constitute a very desirable load for any electricity works capable of supplying it, since the average result would be a fairly steady load, and it is worth a considerable amount of trouble to secure it.

The writer is at present interested in endeavouring to replace a large number of such engines, aggregating over 660 H.P. in one town, by electric motors, and has carefully inquired into a considerable number of cases. In many instances it appears at first sight not very easy to show a consumer where the saving is going to come in, although it is well known to electrical engineers that where the change is made a considerable saving does nearly always occur. A careful examination, however, will usually show that electricity can, especially for intermittent work, compete very easily.

The following is an actual case—a fair sample taken from a considerable number almost exactly similar. The horse-power, average load, price of gas, &c., were all given by the user, who was quite convinced that the load was as stated, and that he was obtaining his power cheaply:—

14-*B.H.P. gas engine* in a joiners' shop, stated to work at an average of half-load for 48 hours a week. (Equivalent to 7 B.H.P. for 624 hours per quarter.)

The Actual Gas Bill is £5 10s. per Quarter.

A brief calculation shows that, for the load and hours stated, electricity at 1·5d. per unit would cost £25.

Illuminating gas is used at 2s. 6d. per 1,000. Now, taking the consumption of gas (at an average of half-load) as 30 cb. ft. per B.H.P.-hour, then, for the load and hours given, the

Gas Bill should Amount to £16 7s. per Quarter.

It is, therefore, evident that the engine does not do one-third of the work with which it is credited.

The B.H.P.-hours equivalent to a gas bill of £5 10s. are 1,467, instead of 4,368, as stated, so that the actual performance of the engine may be stated as a first approximation as

7 B.H.P. for 209 Hours per Quarter.

The engine is, however, actually running for 624 hours per quarter, so it must be running for 415 hours per quarter without load.

Such an engine would consume 50 cb. ft. of gas per hour when running empty, which would amount to 20·75 thousand cb. ft. per quarter, or £2 12s. out of a total bill of £5 10s.

But this amount of gas has done no useful work, and the equivalent must therefore be deducted from the B.H.P.-hours above arrived at.

£5 10s. per quarter = 44,000 cb. ft., less 20,750 cb. ft. = 23,250 cb. ft., which is equivalent to only 775 B.H.P.-hours of useful work per quarter.

The total cost for the gas engine per quarter is:—

	£	s.	d.
Gas	£5	10	0
Cylinder oil, one quart per day at 1s. per gallon		19	6
Bearing oil and waste		5	0
Proportion of wages, starting and daily cleaning, half-hour per day at 7d. per hour	1	3	0
Special cleaning four times a year, takes a man and boy seven hours at 10½d. per hour for the two		6	0
Repairs (given as 2 per cent. on the cost) ...		10	0
Cooling water, say		7	6
	£9	1	0

Or 2·85d. per B.H.P.-hour of useful work.

Now, taking the case for electricity, in this case to be supplied to a polyphase induction motor, at, say, 1½d. per unit, with 82 per cent. efficiency, and assuming that care is exercised in switching off the motor when not required, we have that—

The total cost for the motor per quarter would be:—

	£	s.	d.
775-B.H.P.-hours at 1·32d....	£4	5	0
Oil, say	0	2	6
Repairs (say, 2 per cent per annum on £65) ...	0	6	6
Wages too small to count.			
For contingencies, add 7 per cent.	0	6	6
	£5	0	6

Or 1·55d. per B.H.P.-hour.

The saving due to electric power is, therefore, £16 2s. per annum, or 44½ per cent.

Interest, depreciation, &c., are neglected in both cases, as it is a question of exchange and not of first choice, and, therefore, does not appeal much to the consumer. The inclusion of these items would, of course, make the comparison still more favourable to the motor.

It may be noted also that 30 cb. ft. of gas per B.H.P.-hour, with gas at 2s. 6d. per 1,000, works out to 0·9d. per B.H.P.-hour, which does not at first sight look like an easy figure to beat.

The above calculation might be worked out in many different ways, but to assume that the engine really does average half-power, as stated by the owner, appears as fair a basis as any.

It is probable that in practice the comparison will, in many cases, be even more favourable than the above. Gas engines have usually small overload capacity, so that an engine of rated power, at least equal to the maximum load expected, must be installed. Thus in the above case the 14-B.H.P. engine works at an average of half load (probably much less), and the efficiency would not be above 76 per cent.

On the other hand, standard polyphase induction motors can be obtained with a guaranteed overload capacity of 50 per cent. for one hour, or 25 per cent. for 10 hours, and for intermittent work in such a case as that given a 10-H.P. motor might be safely installed to deal with the load. Such a motor would then operate at an average of about three-quarter load, with an efficiency of at least 82 per cent., and at lighter loads the advantage would be still more marked.

TURBINES AND SUPERHEATED STEAM.

By W. H. BOOTH.

SUPERHEATED steam is valuable in the steam turbine because it permits of a large expansion, and because a large ratio of expansion in the steam turbine is not productive of the same serious loss that indirectly is brought about when excessive expansion is attempted in reciprocating engines.

Probably the economy which arises from the use of superheated steam is due to causes which are entirely different in the turbine and in the reciprocating engine. For a long time now it has been recognised that the turbine avoids the worst fault possessed by the reciprocating engine, namely, the exposure of steam to surfaces of metal which are continually varying in temperature, because in their turn they are exposed to steam that is never long at one pressure or temperature. It follows that hot steam is always turned into the cylinder when the latter is at the minimum temperature, and that there must be a continuous action and reaction in progress between the steam and the metallic surfaces, which it is now well known produce those effects of cylinder condensation that result in an increase of steam consumption of 30 to 50 per cent. above what would be required in adiabatic cylinders. This loss superheating aims to avoid, and it accomplishes the aim more or less completely by carrying into the cylinder about 8 or 10 per cent. extra heat per lb. of steam, and by giving up this heat to the internal surfaces at such a time and in such a manner as to prevent the interchanges of heat to and fro which are so prejudicial to economy.

It has long been boasted that the steam turbine avoids this very serious loss. Every part of the turbine is at the same temperature as the steam which is passing by it, and the passing steam is always at a uniform temperature. That this is so, subject to some slight limitation, is fairly certain. There is no doubt a certain conduction of heat along the shell and along the rotor from the initial towards the exhaust end, but to what extent this changes the temperature of the metals is not clear, for each transverse section of the parts is receiving heat and passing it onwards, so that it would seem that the finally exhausted steam is acquiring heat from the last portion of the machine at the expense of heat abstracted from the first or initial end. The inference to be drawn is, that there will be a certain, if small amount, of initial condensation of steam in the first few inches of a turbine of the Parsons type, and that this small amount could be prevented by superheat. But, apart from this, there is no need for further superheat to take care of the steam dryness, for the steam will only lose such heat afterwards as becomes converted into work.

Evidence seems to be available to show that a turbine may be damaged by superheated steam, and that special material may be necessary for its construction. This is easy to understand. If the condensation in the turbine is small in amount when using saturated steam, it follows that superheated steam will not lose its superheat. In the reciprocating engine, the superheat has usually all disappeared by the time the steam is cut off, and the cylinder is not exposed to superheat temperatures, though the admission valve may be. It is thus quite rational to suppose that metal which will stand the nominal temperature of superheat in a reciprocating engine will not stand the actual temperature in the turbine. It is plain that if superheat gives great economy in the turbine, there is some other cause at work than cylinder condensation. There is some reason to suppose that the thermo-dynamic law plays a part in turbine considerations, and that the working fluid actually does work between an upper limit, T, of temperature, which is that of the superheated steam and the lower limit, t, of the condenser. The condenser seems to be essential. If not kept back, the atmosphere appears particularly powerful in reducing turbine efficiency.

One who took part in the recent discussion drew attention to the small gain secured in the turbine after a superheat of 140° F. had been passed, which would seem to support the above contention, and indicate that the cylinder effects had all been eliminated. The elimination of these effects makes for the great economy of superheat, and, this end attained any further economy must be due to the higher value of T, and obviously, as shown by this correspondent, must be small. He shows how, with still higher degrees of superheat, the reciprocating engine continues to improve in its economy, which all goes to show that the condensation in the cylinder is by no means all shown up when we compare the visible steam at cut-off with the visible steam at a point just before the exhaust. The diagram from the indicator tells us there is much water present at the cut-off. It does not tell us how much, but it is certain there is much still to evaporate after final release, or the curves given by "A Student" would not show further improvement even up to 340° F. of superheat. The steam. turbine ceases to improve much after 140° of superheat, and it is still behind the reciprocating engine in economy, and beyond the 140° line it falls even further behind. This proves that the reciprocating engine owes its economy entirely to the steam tightness of its working parts. It lets no steam escape without doing work, except what escapes by becoming water. The losses of the reciprocating engine when in good order are all of the thermal order. These losses affect the turbine comparatively little. Yet the turbine cannot yet be said to have come up to the performances of the reciprocating engine. There must be a reason for this, and the most obvious reason is leakage, which must, therefore, be enormous; from a quarter to a third of the steam which enters the turbine must escape ineffectively by leakage.

Such being the case, the future progress of the steam turbine must be in the direction of reducing its steam leak losses, for there is no gain further to be expected from superheat after 150°, or thereabouts, except the fractional and calculable gain shown by the formula $\frac{T - t}{T}$. This gain can only be secured by enlarging the machine to take the steam of lighter density and expand it to lower final pressures. A long range of expansion seems to suit the economy of the steam turbine, perhaps because in the long or Parsons forms some of the leakage past the earlier blades is caught up at a later point. But if, as claimed, there are some expansion troubles with turbines of the long variety, it would appear rational on this score to reduce the length to a minimum and endeavour to prevent leakage. Absence of rubbing contacts has been held up as the saving grace of the turbine, and rubbing parts have been held to constitute a fatal bar to any final success of the ordinary piston engine. But there do certainly appear good reasons to suppose that a turbine with actual contact parts so designed as to stop leakage would at once take the lead of any reciprocating engine, and would do so with steam superheated not more than 150° F. "A Student," who wrote in the ELECTRICAL REVIEW, asked, as a result of study of the diagram of performance which he published:—"Is the turbine nearer its limit of economical performance than the reciprocating engine?" With our present lights, we can only reply in the affirmative, but it can also be said that a non-leaking turbine would be *facile princeps* with steam of far less temperatures than its rival. The diagram published by "A Student" is very convincing on this point.

It has long been evident to students of the steam engine that there must have been something seriously amiss with the steam turbine to deprive it of the immense advantage which accrues to it from the fact that, practically, the cylinder fulfils the essential qualification laid down by Watt of being as hot as the steam that enters it. This essential, if not actually attained, is approximated fairly well, as shown by the early limit of superheat necessary to secure best results.

The 1,000-KW. turbine at Newcastle, quoted by Mr. Hunter before the Institution of Mechanical Engineers

tested at 140° and 240° of superheat, shows a gain which *appears* to correspond with the thermo-dynamic formula, that is to say, a reduction of steam consumption from 18·75 to 17·75 lbs. per KW., the bare formula for the conditions giving efficiencies of 40 and 45·5 per cent., a difference of 5·5 per cent., for a steam consumption 5·6 per cent. less. The two percentages are not equivalents, of course, the steam consumption per KW. only falling less than half what the efficiency increases by formula, which may be explained on the ground that the loss by leakage becomes greater as the superheat is increased. With increase of superheat and consequent increase of dimensions, the rate of leakage curve, if found would probably soon cross the curve of increased thermo-dynamic efficiency, and, before that point was reached, the maximum dimensions for best commercial efficiency would already have been exceeded.

The indication of the diagram of the Newcastle tests is roughly that between 140° and 240° F. of superheat, the loss by leakage increases so fast as to reduce the calculated economy by from 8 to 16 per cent., out of 14 to 22 per cent. possible, but for leakage. One cannot exactly calculate the amounts, because it cannot be exactly known at what temperature all condensation in the turbine has ceased, and the true value of the initial T cannot be known, as it is made up of the absolute temperature of saturation plus what remains of the added superheat. A non-leaking turbine would show approximately the thermo-dynamic progress in economy proper to the true secured temperatures, and the real superheat actually remaining could be calculated from the economy.

SOME CRITICISMS ON WORKSHOP PRACTICE.

By E. KILBURN SCOTT, A.M.I.C.E., M.I.E.E.

When in the workshops one is apt to become so accustomed to the methods in vogue that they appear to be the only methods possible. As a matter of fact, however, many of them are at least open to question.

For example, take such a simple matter as the use of a keyhole saw; like every other saw it is made to cut on the *pushing* stroke, and one must needs be very expert to prevent it bending and snapping off. The difficulty would disappear if the saw were turned end for end, and the cutting done on the pulling stroke in the same way as a Japanese workman does his work.

This reminds the writer that whereas in a slotting machine the cutting stroke is in the direction of the bedplate on to which the work is temporarily bolted; a shaping machine, on the other hand, has its working stroke *outwards*, or away from the bed frame. Surely the tool ought to cut on the home stroke, as it would then not only make a cleaner cut, but the ram would be in tension instead of compression, and could be of lighter construction. It would probably also be easier for the attendant to see when he was cutting down to the scribed mark.

For machining large diameter alternator rings it is usual to employ a horizontal face plate lathe or boring mill, and as the diameters of alternator armatures have increased very rapidly of recent years, the distance between the uprights carrying the bridge have to be a considerable distance apart. Now, if instead of rotating the armature ring, the cutting tools are rotated, then these uprights can be done away with, and all that is required is a rigid central column to carry the cross-arm tool-holder. In this way *any diameter* of armature could be machined.

In winding copper wire on to a field coil it is usual to place a brake on the spindle of the spool which is being unwound so as to keep the wire taut. This naturally gives a good deal of side pull to the bearings of the lathe and there is considerable friction. Now, if two spools were to be wound on the same lathe and the wires lead on to the spools from opposite directions, say, top and bottom, these side pulls would be neutralised to a large extent.

There is also room for considerable improvement in winding coils, for the present *tap-tapping* of the wire with wooden mallets is anything but satisfactory. What appears to be wanted is a change gear, which at each revolution of the coil would move a small pair of gripping wheels the exact distance of the diameter of the wire. A knock-off reversing motion could be arranged to start the wire back again when it reached the end of each layer.

Soldering by hand with an iron is another of those finicking things which ought to be banished from an electrical engineering works. Where possible, all joints should be mechanical, but if solder *must* be used it might just as well be done wholesale by first dipping the parts into flux and then into melted solder. There is no reason why, with a little special designing, the joints between armature coils and commutator segments should not be made in this way; anything would be better than the present finicking messy handwork. In some Continental workshops the short-circuiting end rings of alternate current motors are soldered to the rotor conductors by dipping in an annular ring of melted solder.

In the manufacture of mica cloth and mica paper there is far too much handwork. Surely some machine method of laying on the thin laminæ in three layers to break joint could be devised. Compared with such a mechanical miracle as the Hoe printing press, or even an ordinary loom, it should be simple. If some firm gave their cleverest improver the problem to work out with ample facilities for experimenting, I'll be bound he would find a solution in quick time.

Instead of grumbling about the low prices now prevailing, manufacturers should be continually devising short ways of doing the work, or if they cannot devise, then adopt the labour-saving dodges of others. I wonder how many shops in this country can show armature coil taping machines in use? To my knowledge, they had been used in the States and on the Continent four years before one was even tried here. Again, consider the amount of material which the English manufacturer buys ready made, for example, stampings, mica cloth, and even machine frames, spindles, &c., finished. Surely that is only half playing the game.

Prices are likely to go even lower, and for the smaller sizes to pay, they will have to be made as Singers make sewing machines, or Kynochs make small arms. I wonder which firm will be first to paint their small castings by running them on an endless chain through a paint tank. That idea is old enough surely, and if it has been good enough for sewing machines since 20 years ago, it is good enough for motor and dynamo parts now.

ELECTRIC RAILWAYS IN EUROPE.

The experiments with the single-phase alternating current system on the Berlin sections between Nieder-Schöneweide and Spindlersfeld, which were involuntarily discontinued a few months ago, have now been resumed. The object of the trials is to obtain experience in view of the eventual conversion of the Metropolitan Railway to electric traction, and they are being conducted by the Union Electricity Co. It appears that the enforced suspension of the trials was brought about by a collision between the two motor-cars in consequence of the failure of a brake, the cars being damaged, and under the necessity of being temporarily withdrawn for repairs.

The outbreak of the war in the Far East was preceded by a proposal on the part of the Russian Government to appoint a commission, to investigate the conditions under which it might be possible to introduce electric locomotion on the normal gauge railways in that country. It is, however, doubtful whether, in view of recent developments, anything is being done in the direction in question. However that may be, the subject of electric traction on the Russian railways and the trans-Siberian railway was discussed at the recent Electrotechnical Congress held at St. Petersburg, although definite proposals were apparently not brought forward. The congress expressed the opinion that the waterfalls in the empire should be declared to be State property, and be leased to companies or individuals for the generation of power. It is calculated that the rivers which have been investigated represent 600,000 H.P. available for use, while those which have not been studied are estimated as likely to yield 9,000,000 H.P.

It is understood that the Swedish Government is seriously considering the question of transforming the steam railways into electric lines. The question has been under discussion for several years, and the completion of the report by the expert who was sent to investigate the problem in other countries may be regarded as the preliminary step in the direction of practical trials on State railways. It is now announced that the State railway administration

has applied for the allocation of the necessary money for the purpose of establishing two short electric lines leading out of Stockholm, so as to test the respective merits of the systems to be laid down. As mentioned on a former occasion, it is proposed to utilise the water power available in the country, and the native deposits of peat will be drawn upon for the generation of steam. If this scheme is carried into effect, it will render Sweden very largely independent of imported coal for the operation of the railways.

The question of constructing an electric railway between Antwerp and Brussels is now being considered in certain quarters from the standpoint as to whether the line shall be built and equipped by native firms or by German companies. It would, of course, be extremely unpalatable to the Belgians if the contract or concession were secured by the latter, but nothing in this respect has as yet taken place. As to the scheme itself, it is stated that a complete agreement has been arrived at by a modification of the original plan in such a manner that the railway is to be of normal gauge, and the maximum speed not to exceed 55 miles an hour. The right of purchasing the undertaking is to be reserved to the State.

The fate of one of the two rival schemes for the construction of urban and suburban electric railways in Hamburg has now, after a contest extending over two years, practically been settled by the Senate, which has informed the Town Council as a result of a further report from the experts, that a suspended railway can under no circumstances come into question for that city, but solely an elevated or underground line. In the report submitted by Messrs. E. Vermehren & Schnauder, the experts, it is stated that the suspended railway plan for Hamburg, as proposed by the Continental Company for Electrical Enterprises, possesses no advantages from a technical standpoint over the scheme projected by the Siemens and Halske Co. in 1901, but that it gives rise to considerable doubt both in regard to the route selected and the details, in so far as can be judged from the scheme as proposed; and, further, that it is doubtful whether in respect of efficiency the suspended railway equals that suggested in the Siemens & Halske Co.'s project. The Town Council has now, by a two-thirds' majority, resolved to exclude the suspended system from the new contest, and it is expected that the Senate will shortly introduce a modified proposal corresponding to the present wishes of the Council. It was originally estimated that the expenditure on an elevated and underground railway would amount to £2,400,000, but it is probable that the new scheme will exceed this sum.

The communal authorities of Wilmersdorf, which is a suburb of Berlin, have asked the Siemens & Halske Co. to prepare a scheme for the construction of an electric railway so as to provide a more rapid means of transit between that locality and Berlin. It is suggested that Wilmersdorf should be afforded a connection with the underground railway station at the Zoological Gardens. The electrical company proposes to elaborate a project for this purpose in about three months.

The schemes for the establishment of suspended railways in Berlin have not made any material progress, although the Minister for Railways is understood to manifest a sympathetic attitude towards the latest plans submitted by the promoters, whose railway at Elberfeld has been inspected and favourably commented upon by members of the Berlin Municipal Council. It is officially stated by the interested company that the only difficulties in the way of the suspended system in the capital are those of a technical character, which are naturally associated with a comprehensive undertaking of the kind in question.

OUR LEGAL QUERY COLUMN.

[Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.]

"Consultant" writes as follows:—"Clause 3 of Amended Regulation 6 of principal regulation made by the Board of Trade provides that undertakers are to pay the reasonable cost of, or incidental to, the change (including the compensation for any loss or damage incurred in consequence of the change), &c.

"Undertakers, in changing over from 100 volts alternating current system (charge 4½d. per unit less 5 per cent. to 20 per cent. discount) to 240-volt continuous current (charge 4½d. per unit for maximum demand of 180 hours per quarter and 1d. per unit for current used in excess) in order to induce the consumers to give the necessary permission for the change, promised that current would be cheaper, due to the system of maximum demand.

"Certain consumers received no rebate, paid 4½d. per unit, and were not allowed any discount. The undertakers have since altered above tariff to 250 hours in winter quarters to 100 in summer, without notification to consumers, certain consumers who got rebate on 180 hours receive none on present tariff. [It is presumed that this means maximum demand 250 hours in winter quarters and 100 hours in summer quarters.—Eds.]

"Current consumed by 100-volt lamp being, say, average of 4½ watts per candle-power throughout life, with present day 240-volt lamps average about 6½ watts. Undertakers granted written warranty in certain cases to compensate consumer against loss as provided in regulations.

"Have such consumers a legal claim for compensation for 5 per cent. discount, and lower efficiency and shorter life of higher voltage lamps?

"Undertakers free-wired shops and houses under agreement, subject to six months' notice: *i.e.*, 1d. per unit for cost of wiring, 6d. per unit max. demand of 90 hours per quarter, and 1d. per unit for current used in excess. They have since altered this tariff to 125 hours in winter quarters and 50 hours in summer quarters.

"A certain consumer using about £335 worth of current per annum, or 20,000 units, paid an average price of 4·04d. per unit, worked out on ordinary tariff of 180 hours, should have cost about £237, or an average of 3·58d. per unit. On original free-wiring tariff (neglecting rate for cost of wiring) at about £243 or 2·93d. per unit; on present free-wiring tariff, about £304, or 3·67d. per unit.

"This consumer says he has a right to have same terms as free-wiring consumers, but undertakers say not, but offer them subject to five years' agreement. Can they demand this?

"Have the undertakers not acted contrary to their powers under Electric Lighting Acts in altering tariffs without notice to consumers, and have they power to increase the cost to consumer when they had entered into an agreement to supply under certain tariff?

"Cannot any consumer apply to be charged on the same tariff as free-wirers, should he so desire?"

*** Dealing with the first half of "Consultant's" query, which is somewhat confused, it seems clear that before changing over from 100 volts to 240 volts the undertakers were bound, if so required, to make compensation to their consumers. It is to be noticed, however, that the remedy of a consumer who objects to the change is only open to him at the time of the proposed change. Clause 6 paragraph (3) of the amended B.T. regulations provides that:—"Where the consumer withholds his consent after the undertakers have offered to comply with the general terms and conditions imposed by the local authority, and, if not required to do so under those terms and conditions, also to pay the reasonable cost of, or incidental to, the change (including compensation for any loss or damage incurred in consequence of the change), the undertakers may appeal to the Board of Trade, and that Board may, if they think fit, give their consent to the change in such terms and conditions as they impose, and the consent of the Board so given shall, for the purpose of this regulation, have the same effect as the consent of the consumer. Having regard to the terms of this regulation, it seems that a consumer may object to any change in the voltage of his supply, but that he must make his objection at the time. It does not appear that, under this regulation, any claim can be preferred for an alteration in tariff. In the case put by "Consultant," however, a consumer could proceed against the undertakers under the warranty which they have given, but it is not clear that this would justify a claim for discount, as discount appears to have been a concession to all consumers who were supplied under the old *régime*.

As to the second part of "Consultant's" query, it would appear that the undertakers are giving an undue preference to those who are under the free wiring agreement. Such a preference, if established, is clearly contrary to the Electric Lighting Acts. Sec. 19 of the Act of 1882 provides that every company or person within the area shall, on application, be entitled to a supply on the same terms on which any other company or person in such part of the area is entitled to under similar circumstances to a corresponding supply. Sec. 20 provides that the undertakers shall not, in making any agreements for a supply of electricity, show any undue preference to any local authority, company or person, but, save as aforesaid, they may make such charges for the supply of electricity as may be agreed upon, not exceeding the limits of price imposed by or in pursuance of the license, order or special Act authorising them to supply electricity. It is a matter of some doubt whether these sections will prevent undertakers granting special terms to those who take a large quantity. It is submitted, however, that to charge less on that account is legitimate; but to give exceptionally favourable terms to those who enter into a free wiring agreement does not seem to be justifiable.

ROYAL COMMISSION ON LONDON TRAFFIC.

Mr. Albert Gray, counsel to the Chairman of Committees in the House of Lords (Lord Morley), gave evidence before the Commission on Thursday last week. Witness dealt with the present Parliamentary procedure in the case of tramway improvements and the question of the establishment of an advisory board on the matter of London locomotion. He did not think that it would be advisable for a Joint Committee of the two Houses to consider all railway Bills for London, unless a preliminary hearing took place before a separate Board. Such a practice would have a great effect in getting a Bill into shape. At present no Committee inquired into agreed clauses after the first hearing, and therefore a second hearing would enable the whole scheme to be inquired into with regard to its amendments. Even if there were a preliminary inquiry by a locomotion board, the advantages gained would be confined to the scheme itself, and certain Parliamentary details might be overlooked. If one of the members of the Board was a gentleman who had Parliamentary experience, however, the objection would not be so great. It was highly inconvenient that there should be three methods of obtaining powers for the construction of tramways and light railways. He condemned the action of many local authorities in the matter of giving consent to tramway promoters. When electric traction came into being, the terms of purchase under the Tramways

Act ought to have been increased to 42 years, and the powers of purchase should have been vested only with the County Council. The experiment of constituting an advisory board would be well worth trying. Such a body could make annual reports to Parliament, with suggestions for improving means of communication.

In answer to Mr. MURDOCK: No doubt Lord Windsor's Committee had anticipated the establishment of some such Board.

Answering further questions by other members, witness said that he saw great difficulties in giving powers to such a Board.

On Friday Sir THEODORE MARTIN, K.C.B., said he had had 40 years' experience as a Parliamentary agent, and had acted as adviser during that period for the Metropolitan District Railway and the London, Chatham and Dover Railway, and also for a considerable time for the G.W.R. The only tube scheme he had been concerned in the promotion of was the Metropolitan District Railway deep level railway, but he had been opposed to many. He felt that it was a pity that before the tube railways were authorised a general scheme for London railways had not been laid down, and no rule could be laid down which did not take those lines into consideration. He was not able to say whether those lines were laid down in the best way to meet the requirements, but they seemed to have left little room for additional lines for some time to come. Before sanctioning further tube schemes, he felt that they should wait till those authorised were completed, and then they could judge what were the wants to be supplied, and whether the tubes were so favoured by the public as to yield a fair profit on the capital invested. There was no doubt that tube railways now were, to a great degree, experimental, and it had not yet been conclusively proved that they were what they should be as regarded ventilation, risks to life, lifts, &c. He was not in favour of the appointment of a special tribunal to deal with railway schemes. Seeing the multitude of interests affected, Parliament must be the responsible authority, and therefore they should not fetter the judgment of Parliament. The Commission might lay down a scheme for future railway schemes in London, and of course a promoter would come before the Parliamentary Committee at a disadvantage if his Bill deviated from that scheme. After 40 years' experience he felt that the Parliamentary Committee was the best tribunal to deal with railway Bills.

Mr. C. L. MEIK was recalled and examined by Sir J. WOLFE BARRY as to the scheme he had laid before the Commission for two great avenues with two decks extending north to south and east to west. He proposed that on the upper road there should be an elevated railway with a motor road underneath and a tramway line on either side. He gave an alternative scheme for tube railways instead of the overhead railway.

NEW PATENTS APPLIED FOR, 1904.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

3,040. "An improved inter-communication telephone system." A. ECKSTEIN and F. G. BELL. February 8th.

3,045. "Improvements in make-and-break electrical contacts for induction coils." F. H. HALL and C. HALL. February 8th.

3,059. "An improved electrical fire alarm." J. SCOTT and W. CLARK. February 8th.

3,072. "Improvements in cut-outs for electrical conductors." G. H. NASH and T. E. EACHUS. February 8th.

3,101. "Improvements in apparatus for rapidly making and breaking and varying the circuit of electrical currents through the coils of induction apparatus or apparatus of like kind." W. I. BRUCE. February 8th.

3,205. "Improvements in electrical measuring instruments and apparatus for use therewith." W. C. FISHER. February 9th.

3,211. "Improvements in and relating to electric railway systems." H. E. BRADLEY and E. F. BOWEN. February 9th.

3,212. "Improvements in flexible conduits for electric conductors." H. H. LAKE. (J. S. Wilson, United States.) February 9th. (Complete.)

3,216. "An improved fuse-box for electrical cables." W. T. HENLEY'S TELEGRAPH WORKS CO., LTD., and W. H. NICHOLS. February 9th.

3,221. "Improvements in electric telegraph apparatus." S. G. BROWN and A. R. HARDIE. February 9th. (Complete.)

3,243. "Improvements connected with electric arc lamps." L. C. H. MENSING. February 9th.

3,244. "Induction transformer for wireless telegraphy receiving stations." E. DUCRETET. February 9th. (Complete.)

3,251. "Prevention of arcing in electrical apparatus." C. E. BLOOD. February 9th. (Complete.)

3,300 "Improved means for automatically reversing the trolley of an electric car." R. H. PEARSON. February 10th.

3,325. "An improved method of connecting up telephone instruments for use on the intercommunication system." H. P. HARTOG. February 10th.

3,328. "Improvements in switches for electric lighting, heating, &c." A. P. LUNDBERG and G. C. LUNDBERG. February 10th.

3,334. "Improvements in wireless signalling." L. H. WALTER. February 10th.

3,337. "Improvements in dynamos." P. A. J. LAPEYRADE. (Date applied for under Patents Act, 1901, February 10th, 1903, being date of application in France.) February 10th. (Complete.)

3,356. "Improvements in and connected with electric and other lifts and hoists." E. CHAUDOIR. February 10th.

3,385. "Improved automatic telegraph transmitter." D. MURRAY. February 11th. (Complete.)

3,388. "A new or improved method of making electrical contacts for obtaining rectilinear reciprocating action in electric hammers and for other purposes." E. D. HOPCROFT. February 11th.

3,414. "An improved method of breaking the electric circuit in the overhead wires of electric tramways and railways and in other suspended conductors and apparatus therefor." C. C. HEWETT. February 11th.

3,420. "Improvements in straight air automatically acting brakes for trolley or single cars." C. A. ALLISON. (A. B. Levy, United States.) February 11th. (Complete.)

3,426. "Improvements in electric switches." W. DUNCAN, R. MACDIARMID and E. B. BATES. February 11th. (Complete.)

3,429. "Electrical tube-welding machine." R. W. LEACH. February 11th.

3,431. "Improvements in telephones." J. E. KINGSBURY. (The Western Electric Co., United States.) February 11th.

3,440. "Improvements in joints or connections for wires or conductors of electrical energy for telephonic and other uses, and in apparatus employed therein." W. HEATLEY. February 11th.

3,449. "Improvements in or relating to electric clocks." H. A. CAMPICHE. February 11th.

3,460. "Reverse current circuit-breakers and indicators for alternating currents." L. ANDREWS. February 11th.

3,471. "Improvements relating to the charging of accumulators or secondary batteries for electric ignition and other services." T. H. MARSH. February 11th.

3,493. "An improved method of fixing the covers to electrical switches and other articles." J. H. TUCKER. February 12th.

3,508. "Improvements in subscribers' call-signalling devices for telephone exchange systems." J. MACFEE. February 12th.

3,510. "Improvements in alternating-current wattmeters." F. CONRAD. (Date applied for under Patents Act, 1901. February 20th, 1903, being date of application in United States.) February 12th. (Complete.)

3,560. "An improved coin-actuated clock and circuit controller." T. D. INGRAM and L. PHILLIPS. February 12th. (Complete.)

3,577. "Improved hand-operated switch for motor-sparking apparatus." E. J. HARDY. February 12th.

3,581. "Improvements in incandescent electric lamps." THE E.E.L. SYNDICATE, LTD., and G. SWEETSTER. February 12th.

3,588. "Improvements in alternating current motors." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) February 12th.

3,589. "Improvements in alternating current electric motors." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) February 12th.

3,590. "Improvements in means for controlling electric motors." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) February 12th.

3,613. "A new bracket to be used for the purpose of carrying electric lighting lamps, and which may also be used for displaying goods." E. G. TAYLOR and R. L. RATCLIFFE. February 13th.

3,631. "Improvements in circuit controllers for induction coils. W. G. HEYS. (The Varley Duplex Magnet Co., United States.) February 13th. (Complete.)

3,640. "Improved means or apparatus for steadying direct current arc lamps." A. B. CHATWOOD. February 13th.

3,643. "Improvements in electric light baths and the light radiant therapeutic appliances." J. SCOTT. February 13th.

3,660. "Improvements relating to magneto-electric ignition gear for internal combustion engines." R. HENNIG. February 13th. (Complete.)

3,665. "Improvements in motor controllers." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) February 13th.

3,666. "Improvements in electric switches." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) February 13th.

3,677. "Improvements in regulators for alternating current motors." M. LATOUR. (Date applied for under Patents Act, 1901, February 14th, 1903, being date of application in France.) February 13th. (Complete.)

3,691. "Improvements in or relating to electric bell circuits and switches." H. SEFTON-JONES. (H. Schor, France.) February 13th.

3,692. "Improvements in electric bells or gongs." W. A. HEYES and L. O. HEYES. February 13th.

3,694. "A new or improved coherer for wireless telegraphy." F. ORTEGA. (Date applied for under Patents Act, 1901, February 16th, 1903, being date of application in Spain.) February 13th. (Complete.)

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1902.

SNAP SWITCHES. British Thomson-Houston Co. (F. L. Fenn, U.S.A.) 13,727.

ELECTRIC HOISTING APPARATUS. H. H. Lake. (General Electric Co., U.S.A.) 13,738.

SWITCHES. H. H. Lake. (General Electric Co., U.S.A.) 13,741. June 17th.

MOTOR CONTROLLING DEVICES. H. H. Lake. (General Electric Co.) 13,743. June 17th.

FAULT-INDICATOR FOR ELECTRIC CIRCUITS. M. B. Field. 13,792. June 18th.

ELECTRIC SWITCHES. E. M. Hewlett and T. E. Button. (British Thomson-Houston Co., Ltd.) 13,853.

ELECTRIC RAILWAYS ON A ROAD CONTACT OR SECTIONAL CONDUCTOR SYSTEM. (L. Negro, Italy.) 13,877.

TEMPERATURE INDICATOR. L. W. Winship. (A. Heinz et Cie.) 13,956.

LAMINATED ARMATURES FOR VENTILATION THEREOF. Vickers, Son & Maxim Co., Ltd., and A. D. Williamson. 14,775. July 2nd.

TESTING THE MAGNETIC QUALITIES OF MATERIALS. British Thomson-Houston Co., Ltd. (F. Holden.) 15,113.

WEARING APPAREL FOR PROTECTING FROM ELECTRIC CURRENTS UNDER HIGH VOLTAGES. N. Arternieff. 15,124.

REGULATING DEVICE FOR ELECTRICAL MACHINES DRIVEN BY STEAM MOTORS. The Hon. C. A. Parsons. (Communicated.) 15,431. July 10th.

BRUSH GEAR FOR DYNAMOS AND ELECTRO MOTORS. The Electric and Ordnance Accessories Co., Ltd., and R. F. H. H. 15,456. July 11th.

ELECTRIC LIFTS. J. S. Stevens, C. G. Major, E. C. Stevens and P. H. Stevens. 15,764. July 15th.

TRANSMITTING ELECTRICITY TO VEHICLES ON ELECTRIC RAILWAYS. A. Beer. 15,795. July 15th.

ELECTRIC SWITCHES. C. D. Haskins. 15,954. July 17th.

ELECTRICALLY-OPERATED SWITCHES. E. M. Hewlett and T. E. Button. 15,955. July 17th.

ELECTRIC MEASURING APPARATUS. R. Fleming. 15,956.

TELEGRAPHING AND TELEPHONING ON NON-INSULATED SUBMARINE LINES. B. Tychouski and K. Dollinger. 16,121. July 19th.

DYNAMO-ELECTRIC MACHINES. A. Heyland. 16,205. July 21st.

ELECTRIC ACCUMULATORS. H. Danzer. 16,354. July 23rd.

ELECTRIC CHAIN WELDING MACHINE. J. E. Bousfield. (Communicated.) 16,495. July 24th.

TROLLEY HEADS FOR ELECTRICALLY-PROPELLED VEHICLES. M. Mercier. 16,664. July 28th.

PORTABLE TABLE TELEPHONE INSTRUMENTS. L. M. Ericsson. 16,727. July 28th.